



VEGETATION MANAGEMENT PLAN

PATCHS BEACH, SOUTH BALLINA



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**By Andy Erskine, Lisa King and Mike Delaney
of Environmental Training and Employment (Northern Rivers) Inc.**

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FIRST FLOOR, 56 CARRINGTON STREET, LISMORE

PO BOX 1124 LISMORE NSW 2480

PHONE ☎02 6621 9588 FAX ☎02 6622 2518

EMAIL > envite@bigpond.net.au

SUMMARY

This plan, and a series of other plans for coastal sites in Ballina Shire, has been prepared with Coastcare funding. The plan provides practical guidelines for the Patches Beach Dunecare group and others on how to restore, to the extent possible, the diversity and density of the vegetation that is thought to have existed at Patches Beach prior to disturbance by unregulated human use and Bitou Bush infestation.

Patches Beach is a small settlement on a much larger beach that extends uninterrupted from South Ballina to Evans Head. The area managed by Patches Beach Dunecare is approximately 1.5 hectares in size, bounded to the north by a four-wheel-drive access track and to the south by an imaginary line that continues eastward from the end of Sneesbys Lane.

Site inspections were conducted on the 9th and 12th of July and an aerial survey on the 2nd of August 2001. The vegetation at Patches Beach is predominantly coastal sclerophyll, as is typical of a foredune on a barrier beach, dominated by Banksia integrifolia with an Acacia sophorae understorey. A fairly desultory smattering of other species appear in other areas that have long been occupied by Bitou Bush. Southwest of the main site, on privately owned land, is a large vegetation remnant dominated by Melaleuca quinquenervia in wetter areas, with some emergent rainforest species.

There is a significant weed problem at Patches Beach. Apart from Bitou Bush, a major coastal weed that dominates the NSW coastline and is currently being actively controlled by Patches Beach Dunecare, a number of other environmental weeds pose a threat to Patches Beach. The weeds of major concern are Ipomoea cairica (Coastal Morning Glory) and Solanum seaforthianum (Climbing Nightshade). A number of other management problems are also identified in this plan.

Patches Beach has been separated into four work zones, which should be addressed in turn before moving into the next zone. Recommended works for each zone and general recommendations that are applicable to every zone are described in the plan. A number of other recommendations to address general management problems are also included in the plan.

Members of the Patches Beach Dunecare group, in particular Les and Monica Vomiero, should be congratulated for the significant voluntary contribution they have made to the preservation of vegetation at Patches Beach. If the impetus of this work is maintained a significant ecological model will be established that will prove to be a valuable educational and scientific resource. This will be a long term process, involving intensive weed control and some replanting in the early stages, followed by less intense, but regular monitoring and follow-up treatment on a permanent basis. Environmental restoration can be very satisfying and the community/team interaction is renowned for forming long, trusting associations between individuals.

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1. INTRODUCTION

1.1 Background

This plan, and a series of other plans for coastal sites in Ballina Shire, has been prepared with Coastcare funding. The plan provides practical guidelines for the Patches Beach Dunecare group and others on how to restore, to the extent possible, the diversity and density of the vegetation that is thought to have existed at Patches Beach prior to disturbance by unregulated human use and Bitou Bush infestation.

1.2 Aims and Objectives

The aim of this plan is to provide practical guidelines to enable groups and individuals, engaged in rehabilitating Patches Beach, to carry out works that will:

- strengthen the resilience and regenerative capacity of the remnant vegetation,
- establish an evolving vegetation model and source of endemic seed that could be extended to the north and south in the future,
- encourage the accretion of sand on dunes to reduce the impacts of seasonal erosion events,
- improve the general amenity of the area for local residents and visitors (aesthetic, recreational and educational), and
- provide a suitable habitat for local and migratory native fauna.

The specific objectives of the plan and its recommended works are:

- to assess the extent and location of native plant and weed species,
- to make recommendations for the regeneration and rehabilitation of the Patches Beach vegetation remnant, taking seasonality, labour resources, work priority, skills and time required into account,
- to gradually and systematically remove weed species from the Patches Beach remnant, encouraging increased biodiversity and improved habitat value,
- to strengthen and expand the existing vegetation through the planting of appropriate species in areas where natural regeneration is least likely to occur (i.e. highly disturbed, physically compacted and isolated areas),
- to reduce the mobility of sand and consequent loss of beach through erosion,
- to increase public awareness of the importance of coastal vegetation and encourage local stewardship for this piece of the coast, and
- to limit future re-infestation by weed species from adjoining areas.

2. SITE DESCRIPTION

2.1 Location

Patches Beach is not clearly defined by headlands or other obvious geological or landscape features; rather it is a small settlement on a much larger beach that extends uninterrupted from South Ballina to Evans Head (approximately 35 kilometres) (Figure 1). The majority of this coastline is uninhabited, with the northern extreme defined by Richmond River Nature Reserve and the southern end occupied by Broadwater National Park.

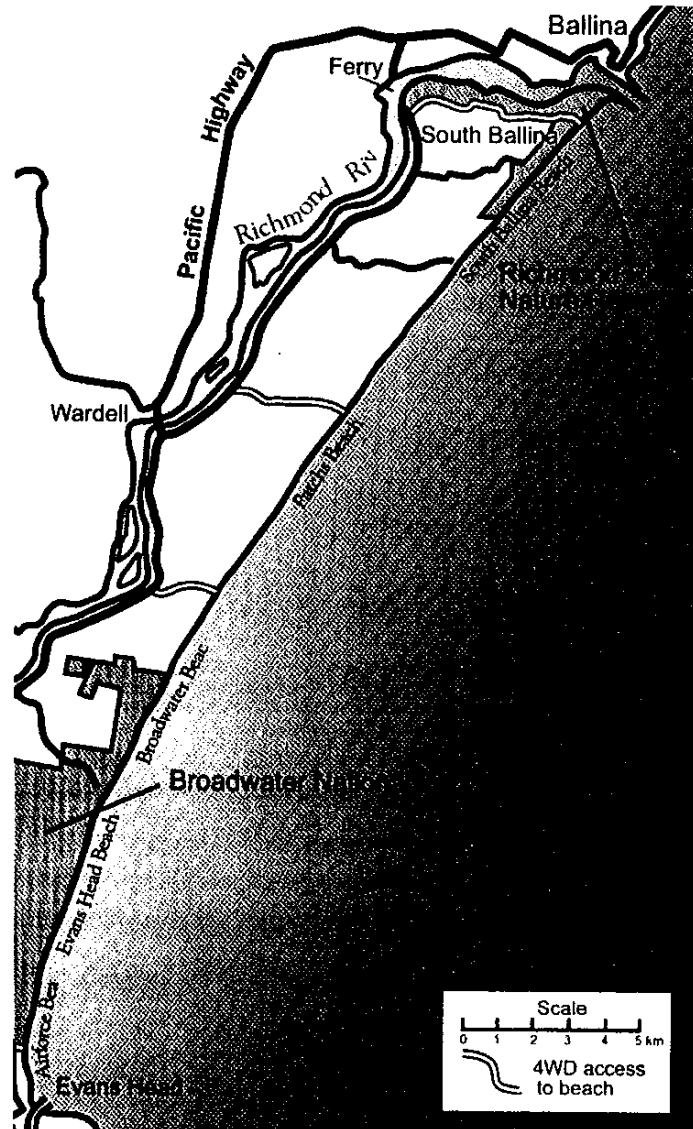


Figure 1. Location map of Patches Beach. Source: NPWS, undated.

The area managed by Patches Beach Dunecare is approximately 1.5 hectares in size, bounded to the north by a four-wheel-drive access track (S28° 56.981 E153° 30.858) and to the south by an imaginary line that continues eastward from the end of Sneesbys Lane (S28°57.077 E153°30.822) (Plate 1).



Plate 1. Patches Beach Dunecare work area. The four-wheel-drive access track is in the left foreground and Sneesbys Lane is obvious in the right background. Note the areas cleared of Bitou (photo: A.Erskine).

2.2 Geomorphology

The settlement of Patches Beach is built upon the eastern edge of the extensive deltaic alluvial plain of the Richmond River. Soils consist of Quaternary alluvium, derived predominantly from weathered basalts, overlying Pleistocene barrier sands (Morand, 1994). These soils are very level to slightly inclined and were most likely once occupied by coastal forest, although now they are predominately used for sugar cane cultivation (Plate 2). A permanently high water table is typical of the area and, in low lying swampy sections, a significant potential acid sulphate soil hazard exists. After inclement weather and the consequent loss of sand, outcrops of “coffee rock” (indurated sands) are often exposed on the beach and the dunes are formed from wind-blown sands of Holocene age (Moffatt, 1997). These recent dune systems are highly mobile and susceptible to blowouts.



Plate 2. The proximity of sugar cane cultivation to the regeneration area and the township of Patches Beach (photo: A.Erskine).

2.3 Climate

Northeastern New South Wales (NSW) experiences a temperate to subtropical climate due to its geographic location. Average temperatures for Ballina Shire range between 19° and 27° and rarely exceed 32°. Average rainfall fluctuates between 1600 and 1700 millimetres per year, with the highest falls in summer (November to April) (Anderson, 1999). Frosts are generally absent in the immediate coastal strip. The prevailing wind is from the southeast, however strong winds from the north are experienced in the spring and summer.

2.4 Land Tenure

The eastern most section of Patches Beach is Crown Land managed by the Department of Land and Water Conservation (DLWC). The car park and picnic area at the northern end of Patches Beach Lane, and some land immediately east of the houses, is owned by Ballina Shire Council. Patches Beach, apart from privately owned land and the car park and picnic area, is zoned 7(f) Environment Protection – Coastal Lands on Ballina Shire Council's Local Environment Plan.

2.5 Site History and Use

Prior to European settlement, peoples of the Bundjalung nation occupied several areas around the Richmond River. Although an archaeological survey was not conducted for this plan, it is highly likely that aboriginal food gathering and other activities were carried out in the area. Small midden sites have been recorded to the north and south of Patches Beach, on old remnant dunes behind the beach (Campbell, 1982). If a midden occurs in the vicinity of Patches Beach it is likely to have been disturbed by past mining or current development, however archeological deposits should be immediately reported to the National Parks and Wildlife Service (NPWS) before continuing further disturbance.

In 1870, alluvial gold was discovered at Shaw's Bay (approximately 12 kilometres to the north), which sparked a rush of New Zealand beach miners. At the height of mining activities in the late 1890s, up to 5000 men were employed at a site called McAuleys Lead on the beach approximately 20 kilometres to the south (Lane, 1982).

After gold mining petered out in the early 1900s, mining interests languished until reawakened by demand for the heavy metals rutile, zircon and monazite. Thousands of hectares of sand dunes were mined along this stretch of coast, until in June 1977 the State Government established the current policy on coastal mineral sand mining. As established leases expired they were not re-granted and mineral sand mining was progressively phased out in conservation areas along the NSW coast (Moffatt, 1997). Soil maps of the region prepared by the Department of Conservation and Land Management in 1995 indicate that Patches Beach was included in mining operations, although this is disputed by at least one local resident. The presence of *Leptospermum laevigatum* on the site however, is probably indicative of past rehabilitation works by sand miners as this southern species is not naturally found north of Nambucca Heads (Harden, 1991).

Another plant species associated with remedial works after mining is Bitou Bush (*Chrysanthemoides monilifera* subsp. *rotundata*), which dominates the entire coastline from Ballina to Evans Head (Plate 3). Bitou however, is well established at local beaches that weren't sand mined so is not conclusive evidence of this activity. Patches Beach Dunecare have sustained a long campaign of dune rehabilitation against extensive masses of invasive Bitou Bush that lie immediately to the north and south of this site. Their efforts are very apparent from the air (Plate 1).

The beach is now mainly used for recreation and by fishermen and four-wheel-drive enthusiasts, and experiences a high degree of visitation on weekends and school holidays.



Plate 3. Looking south towards Patches Beach. Note the extent of Bitou Bush (light green) along the coastline (photo: A.Erskine).

Patches Beach is a small settlement of 30 to 40 people (depending on the season) that was initially developed by a local farmer, Rueben Patch, in 1940. In 2001, there are 16 homes in the immediate proximity of the beach (Plate 1). Patches Beach Dunecare was formed in 1987 and, in that year, conducted major works with Ballina Shire Council to remediate a large blowout that had established at the southern end of the village due to informal four-wheel-drive access. In 1988 a formal four-wheel-drive track and separate pedestrian access were built at the northern end of the beach (Plates 4, 5 and 6).



Plate 4. Looking east along the four-wheel-drive access track (photo: M.Delaney).



Plate 5. Looking westward from the beach along the four-wheel-drive access track (photo: M.Delaney).

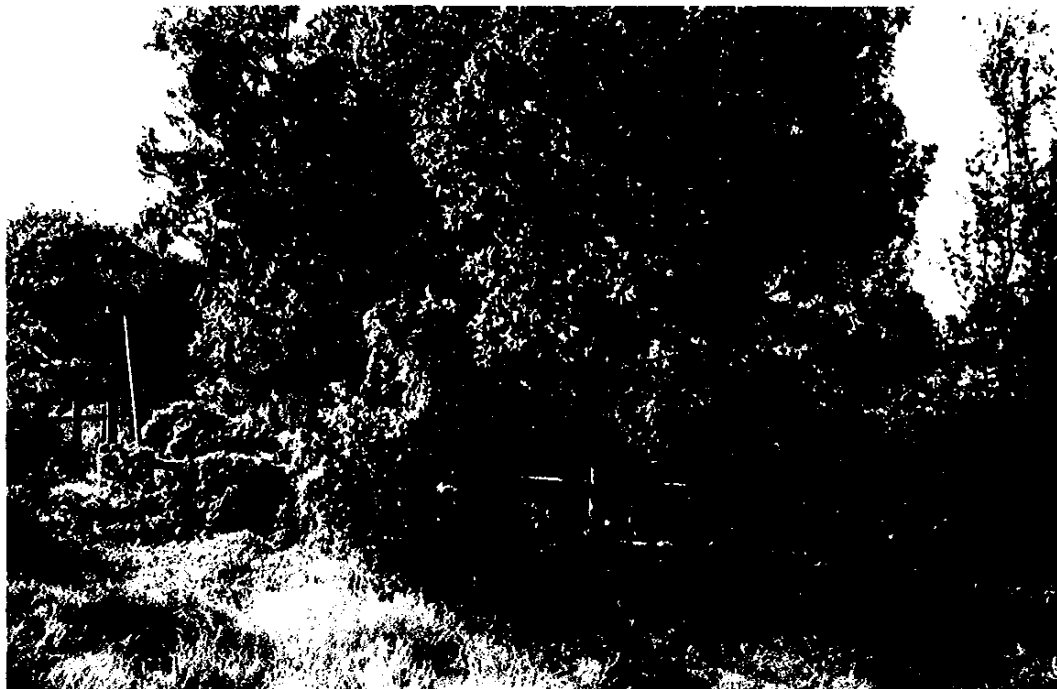


Plate 6. The start of the pedestrian access track. Note the dense infestation of Coastal Morning Glory (photo: M.Delaney).

3. SITE ASSESSMENT

3.1 Methods

Site inspections were conducted on the 9th and 12th of July and an aerial survey on the 2nd of August 2001. Lists of the flora species encountered (natives and weeds) are included as Appendices 1 and 2. Flora species were identified using a variety of guides, some of which are listed in section 7. Characteristics of the vegetation at Patches Beach are described in this plan by identifying vegetation associations, i.e. the most common endemic species on the site with the next most common e.g. *Banksia integrifolia*, *Acacia sophorae* association (Specht and Specht, 1999). In some cases vegetation associations within the site are speculative, based upon a few indicator specimens rather than an established forest type. Resident soils, aspect and neighbouring eco-models are also taken into consideration. This approach is particularly used where prior disturbance has left little or no original vegetation.

3.2 Vegetation

The vegetation at Patches Beach is predominantly coastal sclerophyll, as is typical of a foredune on a barrier beach, dominated by *Banksia integrifolia* with an *Acacia sophorae* understorey (Plate 7). Using Specht's method of structural classification, this *Banksia integrifolia*, *Acacia sophorae* association now ranges from a tall shrubland (shrubs to 2m, Foliage Projective Cover (FPC) 30 – 10%) to a low closed-forest (trees 5 – 10m, FPC 100 – 70%) (Specht and Specht, 1999). Before disturbance Patches Beach would most likely have ranged from a low open-forest (trees 5 – 10m, FPC 70 – 30%) to a closed-forest (trees 10 – 30m, FPC 100 – 70%) (Specht and Specht, 1999). A fairly desultory smattering of other species appear in other areas that have long been occupied by Bitou Bush.

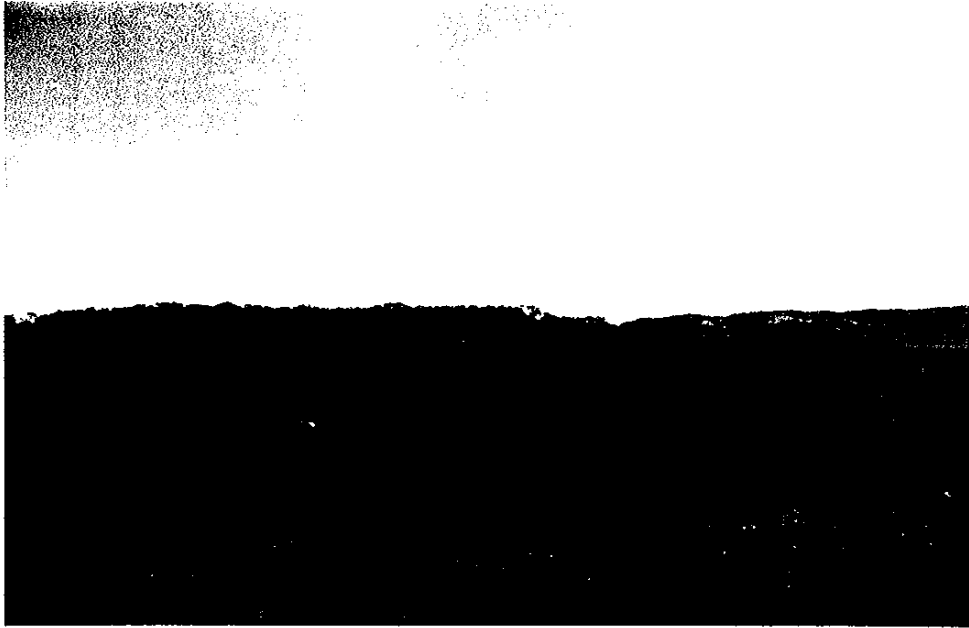


Plate 7. The *Banksia integrifolia*, *Acacia sophorae* association typical at Patches Beach (photo: M.Delaney).

Site inspections did not reveal any rare or threatened plant species but a conspicuous absence of certain species that would normally be represented in this ecotype was observed. This could be due to the residual effects of allopathic chemicals introduced by Bitou, isolation from movement of fauna that could introduce beneficial seed, or in the hungry attentions of the resident wallaby population. Southwest of the main site is a large vegetation remnant dominated by *Melaleuca quinquenervia* in wetter areas, with some emergent rainforest species (listed separately in Appendix 1). This land is privately owned and has suffered fewer disturbances than the beachfront so could be used (with the owner's permission) as a source of endemic seed (Plate 8).



Plate 8. The land to the southwest of Patches Beach (photo: A.Erskine).

There is a significant weed problem at Patches Beach. Apart from Bitou Bush, a major coastal weed that dominates the NSW coastline and is currently being actively controlled by Patches Beach Dunecare, a number of other environmental weeds pose a threat to Patches Beach. The weeds of major concern are *Ipomoea cairica* (Coastal Morning Glory) (Plate 6) and *Solanum seaforthianum* (Climbing Nightshade) (Plate 9). These weeds are both vigorous climbers that smother all forest layers inhibiting natural regeneration and can kill canopy trees due to the weight of vines. Profiles of all the weed species identified at Patches Beach are included in Appendix 3.



Plate 9. Climbing Nightshade on the pedestrian access track (photo: M.Delaney).

3.3 Management Problems

- The site will require constant maintenance as it has very heavy concentrations of Bitou Bush to the north and south on unmanaged lands.
- Wallabies graze on native seedlings as they emerge and on planted stock. Plastic tree guards have been used in the past but need to be more robust as the wallabies have pushed them down to get at trees. Hares and foxes are also present at Patches Beach and there is evidence of cats predating on local wildlife.
- Current management agency policy does not allow for paid qualified workers to carry out remediation or maintenance works on public lands, consequently the task falls upon the shoulders of a small team of dedicated volunteers. Unfortunately this work attracts few young volunteers and the heavy or very exposed work conditions can become onerous to aging retirees. Volunteer burnout is prevalent in the Ballina Shire as a result. Patches Beach also has only a small population and few residents are interested in volunteering time to Dunecare. Dunecare efforts have been supplemented by teams provided by EnvITE or Conservation Volunteers Australia in the past but the long term future of this assistance is subject to Government policy and funding.
- A resident at the northern end of the site is reluctant to have Bitou removed from around his home as he feels this could reduce his degree of privacy.
- The site suffers serious erosion after storm events (in 1995 a four metre drop off from the dune to the beach was reported). Fences constructed to control pedestrian access have been lost to erosion in the past.
- This section of beach experiences high visitation on weekends and holidays, including use by four-wheel-drive vehicles, horse riders and fishermen. This sometimes results in damage to the dunes through inappropriate uses, such as sand sliding and forging new accessways or four-wheel-drive tracks.
- Public amenities and facilities are not adequately maintained. The public toilets and picnic area at Patches Beach have fallen into disrepair and can no longer be used (Plate 10).
- Up until now there has been no restoration plan for this site and work has been mainly carried out behind the homes of Dunecarers rather than on areas with the most potential.
- Some domestic gardens in close proximity to the site contain exotic species that are potentially invasive (Plate 11).
- There is little diversity (insitu resilience) in the existing flora, therefore the site has little opportunity to evolve or act as habitat for fauna. Migratory resilience of the site, however, is good due to the proximity of a large, relatively intact vegetation remnant to the southwest (Plate 8).



Plate 10. The overgrown picnic area at the end of Patchs Beach Lane (photo: M.Delaney).



Plate 11. Environmental weed *Bryophyllum pinnatum* (Resurrection Plant) growing in a garden at Patchs Beach (photo: M.Delaney).

4. RECOMMENDATIONS

4.1 Regeneration Works

While the principal members of Patches Beach Dunecare number only two, several other groups are available to assist with regeneration works. It is envisaged that the restoration of Patches Beach could be conducted by a combination of Green Corps, Work for the Dole teams, Patches Beach Dunecare, Conservation Volunteers Australia, Wardell Public School, Council Parks and Gardens staff, and EnviTE bush regenerators. The tasks described in this report however, require differing degrees of expertise depending on the sensitivity of the area and the job to be performed (e.g. selective herbicide spraying should be carried out by experienced personnel with good plant identification skills) and should be allocated to workers with the appropriate skills. For example, if trained workers are not available and volunteers or trainees are able to work, activities should be confined to the less sensitive areas.

The site has been separated into four work zones (Figure 2), which should be addressed in turn before moving into the next zone. Recommended works for each zone and general recommendations that are applicable to every zone are outlined in Table 1. Recognised weed treatment methods are described in Appendix 4 and specific treatment methods recommended for each weed species encountered at Patches Beach are outlined in Appendix 5. A list of suggested tools and equipment is included as Appendix 6.

The sequence of proposed works is based upon the urgency to arrest certain types of degradation, seasonal weather conditions, provision of follow up maintenance, and ability for areas to naturally regenerate after initial treatment. It is strongly recommended that this sequence is adhered to, to prevent reinfestation of treated areas with weeds that may be more aggressive than those originally there and to reduce the detrimental effects of exposure to salt laden winds.

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Table 1. Recommended Actions for Work Zones

PROJECT PREPARATION	ACTION
Zone A	<ul style="list-style-type: none"> • Acquaint residents with plan, endeavour to get cooperation for rehabilitation works, remove potentially invasive plants from proximal gardens, replace with endemic or non-invasive species of similar habit or appeal e.g. swap Fianell Flowers for Resurrection Plant. • Collect local suitable seed and propagate (EnvITE could help with this on a cost recovery basis). • Clear weeds from the defined western edge of the zone and prepare for late summer planting of salt tolerant rainforest species such as Tuckeroo, Cheese Tree, Corkwood, Cottonwood, and Macaranga into the existing swale. These plantings will have to be protected from wallabies either with tree guards or wallaby repellent sprays. • It was noticed during site surveys that the weed species Climbing Nightshade (<i>Solanum seaforthianum</i>) is gathering impetus and could prove very troublesome in the future. When it next flowers, a dedicated search of the zone should be conducted and specimens hand removed.
Zone B	<ul style="list-style-type: none"> • Plant groundcover species such as <i>Hibbertia scandens</i> (Guinea Flower), Pig Face, Goats Foot, and Tetragonia on bare areas to stabilise. • Gather Spinifex seed when observed blowing about and bury whole seed heads in foredunes to the depth of about 20cm, a slit in the sand with a spade will be sufficient for this. Spinifex seed will only germinate in the complete absence of light. When large amounts of seed are available it can be stored for some time in hessian sacks and used when needed (Spinifex collection and planting is a good activity for school children). • The occasional broadcasting of Nitram® fertilizer over Spinifex has proved to encourage rapid growth on developing dunes. This operation should only be carried out when rain is imminent as fertilizer may burn foliage.
Zone C	<ul style="list-style-type: none"> • It was noticed during site surveys that the weed species Climbing Nightshade (<i>Solanum seaforthianum</i>) is gathering impetus and could prove very troublesome in the future. When it next flowers, a dedicated search of the zone should be conducted and specimens hand removed. • Treat the single Asparagus Fern (<i>Protasparagus plumosus</i>) seen in the centre of the little paddock at the southern end of the zone before it has a chance to spread. • Consider a temporary shadecloth fence around the Casuarinas at the southern end of the zone (blowout repair) as this area had the highest degree of natural regeneration seen but predation by wallabies (or hares) was evident. Shadecloth fences may also be desirable to mark resident's boundaries until plantings become established. Council will need to be consulted to establish accurate property boundaries.
Zone D	<ul style="list-style-type: none"> • It was noticed during site surveys that the weed species Climbing Nightshade (<i>Solanum seaforthianum</i>) is gathering impetus and could prove very troublesome in the future. When it next flowers, a dedicated search of the zone should be conducted and specimens hand removed. • Maintain this zone of relatively well established vegetation from further weed encroachment. Gently trim back Wattle that threatens to smother emergent natives.
GENERAL RECOMMENDATIONS	<ul style="list-style-type: none"> • Work strips from west to east in each zone and establish a southern boundary by overspraying Bitou on that edge. The four-wheel-drive track is considered to be the northern boundary of the site. • Retain Bitou and Lantana to the east of worked areas if they are providing shelter for plantings behind. • Maintain previously worked areas by spraying or hand weeding. Avoid creating piles as these are troublesome later, it is better to cut up material and scatter. • When breaking new ground always consider what resources are available for follow-up treatments. If you have a team at your disposal confine their activities to an area that they can treat thoroughly or maintenance may become overwhelming. Discuss these limits, objectives and desired results openly with the team as well as the team supervisor to establish a common picture of what needs doing: this will lead to greater mutual satisfaction as well as more effective primary treatment. • Retain dead trees on the site if they can act as bird perches as this may help to introduce new seed. • It is recognised that the volunteer time the principal Dunecarers have available for this project is limited to a total of about four hours a week. This time is best spent in low volume but frequent application of targeted herbicide, monitoring, and coordination of the available labour market programs that offer their services. Volunteer work should not become onerous. • Seed of desirable species should be collected when available (December, January for <i>Banksia integrifolia</i>, <i>Acacia sophorae</i> and <i>Cupaniopsis anacardioides</i>). Contact EnvITE to take delivery of this seed for propagation on a cost recovery basis.

Note: weeds encountered in each zone should be treated as per Appendices 4 and 5.

4.1.1 The Ideal Sequence of Recovery

Adherence to the recommendations in Table 1 will result in the following sequence of recovery. If this sequence of events is not noted, regeneration activities have not been successful and techniques used may need to be modified or improved.

1. Sprayed areas of Bitou will yellow and die, which will allow more physical space for existing native vegetation to expand. Dead material should be broken up by stamping or chopping otherwise it will harbour Bitou seedlings.
2. Green trash, that has been evenly chopped up and left on the ground, will break down and form a moisture retentive mulch (weeds must not be piled up). Aerial vines, that have been severed and left in trees, will deteriorate, so that light is slowly increased allowing plants beneath to acclimatise to increased levels of light and salt. Don't pull vines or material, such as Morning Glory or Bitou, from trees, cut it at head height to allow maintenance egress and allow it to fall apart insitu.
3. Plantings are most successful in late summer and should be protected by tree guards and planted in the lee of material retained to their east. These will gather impetus and, within a three to four year period, achieve a wedge-shaped canopy. With the resultant decrease in light, germination of weeds in these areas should be minimal.
4. Diverse groundcovers that have been encouraged to grow on the foredune should quickly colonise accreted sands. Losses will be experienced during erosion events but this will be reduced as the swathe of vegetation in this zone increases. Beach erosion is a natural and dynamic process and must be accepted as inevitable.

4.1.2 Plant Selection Guidelines

Patches Beach has a low potential to naturally regenerate. Areas cleared of Bitou will need to be planted with endemic replacement species. Care should be taken to use appropriate species that has been grown from seed collected nearby (refer to the plant propagation publications in section 7). Many species, such as *Banksia integrifolia*, have a very broad geographic range but genetic differences are found across this range. Trees found on the site have adapted to the specific conditions that occur at Patches Beach.

The introduction of species that would not naturally occur on this site is not recommended. This can be detrimental to the ecological functions of the vegetation community. If the aims of the restoration project are to facilitate the establishment of a sclerophyll forest, then planting trees that do not belong will detract from achievement of this aim.

4.2 General Management Recommendations

- Patches Beach Dunecare should continue to apply for assistance from EnviTE Work for the Dole teams and Conservation Volunteers Australia volunteers and/or Green Corps. However, care should be taken to allocate tasks to these groups that are appropriate to the participants' level of skill.
- Frequent liaison with Ballina Shire Council and DLWC should also be maintained so that relevant management and staff are familiar with the progress of works at Patches Beach and to enable the provision of assistance where possible.
- A brochure or flyer circulated to residents and the local school (Wardell Primary School) may encourage increased volunteer participation and discourage retention or planting of environmental weeds in local gardens.
- Ballina Shire Council should provide improved maintenance for the public toilets and picnic area. Signage should also be upgraded and include information on the importance of dune environments and regulations governing use of the area by four-wheel-drivers, dog walkers and horse riders.
- In recognition of his long term commitment to Patches Beach Dunecare, Ballina Shire Council should investigate naming the picnic area "Les Vomiero Park".
- A laminated double-sided copy of Figure 2 and Table 1 should be used as an on-site work plan to guide volunteers.
- Ballina Shire Council to implement a bush regeneration program utilising Council staff or contractors. The program would provide ongoing assistance to community groups particularly with highly specialised activities such as spot spraying.
- Training for Council Parks and Gardens staff in best practise environmental weed control and techniques for stimulating natural regeneration.

4.3 Other Issues

Fauna

Snakes, ticks, ants, mosquitoes and chiggers (the larval mites that cause "scrub itch") can potentially cause discomfort, disease and serious illness. The best way to avoid complications is to minimise the risk of bites. Always wear protective clothing i.e. long sleeves and trousers tucked into sturdy boots, socks and a hat. Apply repellent (particularly one containing pyrethrums/DEET/triclosan antiseptics) to skin and clothing, and always take repellent and a comprehensive first aid kit into the field. Lignocaine gel can give localised relief from bites. Ticks should be killed before removal (by directly applying repellent), as the shock of physical removal can stimulate them to release more toxin into their host.

Patches Beach, and the entire beach from South Ballina to Evans Head, provides habitat for the Pied Oystercatcher (Plate 12) listed as vulnerable, Schedule 2, on the NSW *Threatened Species Conservation Act* 1995. These shy birds are declining in numbers due to disturbance of their breeding sites on beaches (NPWS, undated). To prevent impacts on the Pied Oystercatcher, keep off the dunes (i.e. use only accesses provided), keep dogs on a leash, do not interfere with birds or chicks if observed, and check wheel ruts for sheltering chicks before driving off the beach (NPWS, undated).

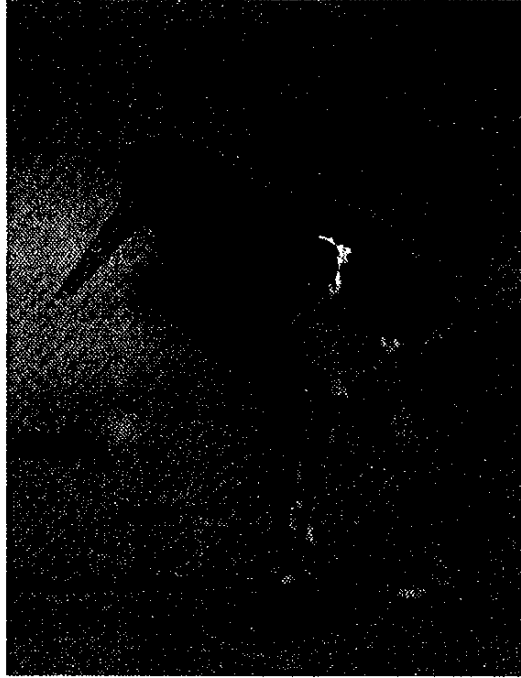


Plate 12. The threatened Pied Oystercatcher (photo: B.Cheers)

Water

Water at Patches Beach is a scarce resource as houses rely solely on tank and bore water. Plantings should be done during the wet season or use water crystals to prevent water loss. A watering point has been installed in the project area from one of the Dunecarer's bores.

Community Education

Surfers, fishermen, four-wheel-drive enthusiasts, horse riders, and dog walkers frequently visit Patches Beach. Regeneration workers can provide important community education by explaining the value of the work being conducted. Erection of signage describing the project and usage guidelines can also provide information to the community. Ballina Shire Council or Coastcare may be able to assist with signage costs.

Beach Erosion

Beach erosion is a natural and dynamic process that is often hastened by misuse of the dunes. Beach users can cause erosion by developing informal tracks or sliding down and digging into dune scarps. If an area is obviously being used in this manner, it may be worth fencing or brush matting the spot to discourage the practice. Explanatory signage may also prove useful. Areas where blowouts are developing will require rehabilitation works.

Rubbish Dumping

Dumping of rubbish and garden waste is a problem in most natural areas. It is also one of the main ways that exotic plants are introduced in vegetation remnants. Explanatory signage and personal communication with anyone observed dumping may discourage the practice, and always remove any rubbish encountered when working.

4.4 Monitoring

It is important to monitor the project through “before and after” photography. This provides a record of progress that will prove useful to attract further funding and identify successful techniques, as well as providing reassurance to volunteers that their work has been useful. The slow success of rehabilitation works is best seen when specific photo points are established during the initial stages of the project and continually used. Photo points should be identified with a permanent marker (some sort of stake or picket) and taken consistently of the same site from the same direction. This can be established by referring to past photos prior to taking each photo. Photographic records should be taken at least seasonally (i.e. three to six monthly) and after major events, such as big plantings, storms or fires. Records of working bees, including attendance, activities undertaken, weather constraints, successes and failures etc. are also invaluable monitoring tools. An example of a work record sheet is included as Appendix 7.

Another important aspect of monitoring is maintaining species lists. The flora and weed lists in this plan (Appendices 1 and 2) should be continually updated as new species are encountered. It is also useful to establish a fauna species list for the site, particularly as the site provides habitat for a threatened species (the Pied Oystercatcher). This information should be shared with land managers such as Ballina Shire Council, DLWC and NPWS.

5. CONCLUSION

Members of the Patches Beach Dunecare group, in particular Les and Monica Vomiero, should be congratulated for the significant voluntary contribution they have made to the preservation of vegetation at Patches Beach. Their work is particularly evident when the site is viewed from the air and Patches Beach is obvious as an island in a sea of Bitou.

If the impetus of this work is maintained a significant ecological model will be established that will prove to be a valuable educational and scientific resource. There are many good reasons for doing this work including conservation of native species and vegetation communities, improved habitat for wildlife, reduction of erosion processes, and general public amenity.

This will be a long-term process, involving intensive weed control and some replanting in the early stages, followed by less intense, but regular monitoring and follow-up treatment on a permanent basis. Environmental restoration can be very satisfying and the community/team interaction is renowned for forming long, trusting associations between individuals.

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APPENDIX 1: Native Plant Species List

Trees and Shrubs

Family	Scientific Name	Common Name
Arecaceae	<i>Livistona australis</i>	Cabbage Palm
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak
Epacridaceae	<i>Leucopogon parviflorus</i>	Coastal Bearded Heath
Euphorbiaceae	<i>Breynia oblongifolia</i>	Breynia
Euphorbiaceae	<i>Glochidion sumatranum</i>	Umbrella Cheese Tree
Euphorbiaceae	<i>Macaranga tanarius</i>	Macaranga
Euphorbiaceae	<i>Mallotus discolor</i>	Yellow Kamala
Euphorbiaceae	<i>Omalanthus nutans</i>	Bleeding Heart
Fabaceae	<i>Acacia sophorae</i>	Coastal Wattle
Malvaceae	<i>Hibiscus tiliaceus</i>	Cottonwood Hibiscus
Moraceae	<i>Ficus obliqua</i>	Small-leaved Fig
Moraceae	<i>Ficus watkinsiana</i>	Strangling Fig
Myrtaceae	<i>Austromyrtus dulcis</i>	Midgin Berry
Myrtaceae	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark
Pandanaceae	<i>Pandanus tectorius</i>	Screw Pine
Proteaceae	<i>Banksia integrifolia</i>	Coast Banksia
Sapindaceae	<i>Cupaniopsis anacardioides</i>	Tuckeroo
Solanaceae	<i>Duboisia myoporoides</i>	Corkwood

Climbing Plants

Family	Name	Common Name
Apocynaceae	<i>Parsonia straminea</i>	Common Silkpod
Dilleniaceae	<i>Hibbertia scandens</i>	Twining Guinea Flower
Dioscoraceae	<i>Dioscorea transversa</i>	Native Yam
Menispermaceae	<i>Stephania japonica</i> var. <i>discolor</i>	Snake Vine
Rubiaceae	<i>Coelospermum paniculatum</i>	Coelospermum

Groundcovers, Grasses and Ferns

Family	Name	Common Name
Aizoaceae	<i>Carpobrotus glaucescens</i>	Native Pigface
Commelinaceae	<i>Commelina cyanea</i>	Blue Commelina
Cyperaceae	<i>Isolepis nodosa</i>	Knobby Clubrush
Lomandraceae	<i>Lomandra longifolia</i>	Mat Rush
Peperomiaceae	<i>Peperomia leptostachya</i>	Peperomia
Phormiaceae	<i>Dianella caerulea</i>	Flax Lily
Phormiaceae	<i>Dianella crinoides</i>	Lily
Poaceae	<i>Imperata cylindrica</i>	Bladey Grass
Poaceae	<i>Oplismenus aemulus</i>	Basket Grass
Poaceae	<i>Spinifex sericeus</i>	Hairy Spinifex

South West Site

Trees and Shrubs

Family	Scientific Name	Common Name
Araliaceae	<i>Polyscias elegans</i>	Celery Wood
Arecaceae	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm
Arecaceae	<i>Livistona australis</i>	Cabbage Palm
Casuarinaceae	<i>Casuarina glauca</i>	Swamp Oak
Ebenaceae	<i>Diospyros fasciculosa</i>	Grey Ebony
Elaeocarpaceae	<i>Elaeocarpus obovatus</i>	Hard Quandong
Euphorbiaceae	<i>Breynia oblongifolia</i>	Breynia
Euphorbiaceae	<i>Glochidion sumatranum</i>	Umbrella Cheese Tree
Euphorbiaceae	<i>Macaranga tanarius</i>	Macaranga
Euphorbiaceae	<i>Mallotus discolor</i>	Yellow Kamala
Euphorbiaceae	<i>Omalanthus nutans</i>	Bleeding Heart
Eupomatiaceae	<i>Eupomatia laurina</i>	Bolwarra
Fabaceae	<i>Acacia melanoxylon</i>	Blackwood
Lauraceae	<i>Cryptocarya triplinervis</i>	Three-veined Laurel
Lauraceae	<i>Litsea australis</i>	Brown Bolly Gum
Lauraceae	<i>Neolitsea australiensis</i>	Green Bolly Gum
Monimiaceae	<i>Wilkiea huegeliana</i>	Rough-leaved Wilkiea
Moraceae	<i>Ficus fraseri</i>	Sandpaper Fig
Moraceae	<i>Ficus watkinsiana</i>	Strangling Fig
Myrtaceae	<i>Acmena smithii</i>	Lily Pilly
Myrtaceae	<i>Austromyrtus dulcis</i>	Midgin Berry
Myrtaceae	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark
Myrtaceae	<i>Pilidistigma glabrum</i>	Plum Myrtle
Myrtaceae	<i>Rhodomyrtus psidioides</i>	Native Guava
Pittosporaceae	<i>Pittosporum revolutum</i>	Hairy Pittosporum
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum
Rutaceae	<i>Acronychia imperforata</i>	Beach Acronychia
Rutaceae	<i>Acronychia wilcoxiana</i>	Silver Aspen
Rutaceae	<i>Flindersia bennettiana</i>	Bennets Ash
Sapindaceae	<i>Alectryon coriaceus</i>	Beach Bird's-eye
Sapindaceae	<i>Arytera divaricata</i>	Coogera
Sapindaceae	<i>Cupaniopsis anacardioides</i>	Tuckeroo
Sapindaceae	<i>Guioa semiglauc</i>	Guioa
Sapindaceae	<i>Jagera pseudorhus</i>	Foam Bark
Sapindaceae	<i>Mischocarpus pyramidalis</i>	Yellow Pear Fruit
Solanaceae	<i>Duboisia myoporoides</i>	Corkwood
Sterculiaceae	<i>Commersonia bartramia</i>	Brown Kurrajong
Thymeleaceae	<i>Wikstroemia indica</i>	Wikstroemia
Zingiberaceae	<i>Alpinia caerulea</i>	Native Ginger

Climbing Plants

Family	Name	Common Name
Dilleniaceae	<i>Hibbertia scandens</i>	Twining Guinea Flower
Philesiaceae	<i>Geitonoplesium cymosum</i>	Scrambling Lily
Smilacaceae	<i>Smilax australis</i>	Sarsaparilla

Groundcovers, Grasses and Ferns

Family	Name	Common Name
Commelinaceae	<i>Commelina cyanea</i>	Blue Commelina
Lomandraceae	<i>Lomandra longifolia</i>	Mat Rush
Phormiaceae	<i>Dianella caerulea</i>	Flax Lily
Phormiaceae	<i>Dianella crinoides</i>	Lily
Poaceae	<i>Oplismenus aemulus</i>	Basket Grass

APPENDIX 2: Weed Species List

Family	Name	Common Name
Araliaceae	<i>Schefflera actinophylla</i>	Umbrella Tree
Araucariaceae #	<i>Araucaria cunninghamii</i>	Hoop Pine
Asparagaceae	<i>Protasparagus aethiopicus</i>	Ground Asparagus
Asparagaceae	<i>Protasparagus plumosus</i>	Climbing Asparagus
Asteraceae	<i>Ageratum houstonianum</i>	Blue Billy Goat
Asteraceae	<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>	Bitou Bush
Asteraceae	<i>Gazania rigens</i>	
Asteraceae	<i>Senecio madagascariensis</i>	Fireweed
Cactaceae	<i>Opuntia stricta</i>	Prickly Pear
Casuarinaceae #	<i>Casuarina equisetifolia</i>	Coastal She Oak
Convolvulaceae	<i>Ipomoea cairica</i>	Coastal Morning Glory
Convolvulaceae	<i>Ipomoea indica</i>	Blue Morning Glory
Dracaenaceae	<i>Sansevieria trifasciata</i>	Mother-in-law's Tongues
Euphorbiaceae	<i>Euphorbia cyathophora</i>	Painted Spurge
Fabaceae #	<i>Acacia longifolia</i>	Sydney Golden Wattle
Fabaceae	<i>Erythrina x sykesii</i>	Coral Tree
Fabaceae	<i>Senna x floribunda</i>	Smooth Senna
Fabaceae	<i>Senna pendula</i> var. <i>glabrata</i>	Winter Senna
Lauraceae	<i>Cinnamomum camphora</i>	Camphor Laurel
Lamiaceae	<i>Salvia</i> sp.	Salvia
Lamiaceae #	<i>Westringia fruticosa</i>	Westringia
Myrtaceae #	<i>Eucalyptus torrelliana</i>	Cadagi
Myrtaceae #	<i>Leptospermum laevigatum</i>	Coast Tea Tree
Passifloraceae	<i>Passiflora edulis</i>	Edible Passionfruit
Passifloraceae	<i>Passiflora suberosa</i>	Corky Passionfruit
Passifloraceae	<i>Passiflora subpeltata</i>	White Passionfruit
Phytolaccaceae	<i>Phytolacca octandra</i>	Inkweed
Poaceae	<i>Digitaria didactyla</i>	Couch Grass
Poaceae	<i>Stenotaphrum secundatum</i>	Buffalo Grass
Solanaceae	<i>Solanum mauritianum</i>	Wild Tobacco Bush
Solanaceae	<i>Solanum seafortianum</i>	Climbing Nightshade
Tropaeolaceae	<i>Tropaeolum majus</i>	Nasturtium
Verbenaceae	<i>Lantana camara</i>	Lantana

Denotes native plants that are growing on the site that would not naturally occur at Patches Beach

APPENDIX 3: Weed Profiles

TREES AND SHRUBS

Araliaceae

Schefflera actinophylla

Umbrella Tree

Native of North Queensland and naturalized in coastal districts of northern NSW. A tree to ten metres high, often multi-stemmed and sometimes epiphytic on rainforest trees (Harden, 1992, p.87), making removal difficult. Birds disperse its red fruit. Adventitious roots form readily from stem segments that remain in contact with the ground.

Asteraceae

Chrysanthemoides monilifera subsp. *rotundata*

Bitou Bush

Native of South Africa. An erect, shallow-rooted, densely branched perennial shrub up to three metres high (Auld and Medd, 1992). It grows on sand dunes and forest margins near beaches and poses a serious threat to native sand dune vegetation (Harden, 1992, p.315). These plants can invade and overwhelm all plant communities on the coastal system, growing in the open or in the shade of other plants. Up to 48,000 seeds per plant can be produced with a viability of up to seven years. Fruits are attractive to birds (Buchanan, 1989). There is increasing evidence that long-term domination of coastal frontal dunes by Bitou Bush leads to instability and increased erosion (Stanley et. al., 1989). It is a declared W3 noxious weed (i.e. must be prevented from spreading and its numbers reduced).

Cactaceae

Opuntia staccato

Prickly Pear

Native to North and South America. A low spreading, shallow rooted perennial cactus forming large clumps up to 1.5 metres tall. It has succulent segments up to 20 centimetres long with clumps of short tufts of hair and spines. Flowers are bright yellow and fruit is dark purple (Auld and Medd, 1992). Birds disperse seeds and adventitious roots will form if segments contact the ground. It is a declared W4 (f) noxious weed (i.e. cannot be sold, propagated or knowingly distributed).

Erythrina x sykesii

Coral Tree

Tree to 15 metres high. Prickles on trunk with black, glabrous branches. Flowers most of the year but fruit not set. Readily grows from cuttings and old stumps. Hybrid that probably originated in New Zealand (Harden, 1991, p. 414).

Senna x floribunda

Smooth Senna

Native of Mexico. A shrub one to three metres high. It does not produce root nodules and is frequently naturalized in moist sclerophyll forest and disturbed rainforest (Harden, 1991, p.319). It produces a large number of seeds, which appear to have a long viability, possibly for years.

Senna pendula var. *glabrata*

Winter Senna

Native of South America. A spreading shrub to three metres high, it does not produce root nodules and is widely naturalized in coastal areas (Harden, 1991, p.319). It produces a large number of seeds, which appear to have a long viability, possibly for years. Can regenerate from cut material in moist conditions. Can be seen flowering throughout the year, flowers are bright yellow.

Lauraceae

Cinnamomum camphora

Camphor Laurel

Native of China and Japan. A large tree of spreading habit that can grow to approximately 25-30 metres. It has abundant seed production, effective dispersal mechanism, mainly by birds, and some seed dormancy. It is a hardy, long-living competitive tree which can also reproduce rapidly by suckering to form single species stands. Camphor Laurel prefers deep, well-drained red soil but will grow well on alluvial soil; it cannot, however, tolerate prolonged flooding (Firth, 1992, p.69). It is extensively naturalized in coastal areas on the North Coast of NSW (Harden, 1990, p.144). It is a declared W4 (d) noxious weed (i.e. must not be sold, propagated or knowingly distributed and must be fully and continuously suppressed and destroyed).

Solanaceae

Solanum mauritianum

Wild Tobacco Bush

Shrub or tree to four metres. Leaves discolourous, upper surface green and pubescent, lower surface greyish and tomentose. Flowers autumn and spring. Widely naturalised in coastal areas and common in rainforest regrowth. Native of South America (Harden, 1992, p. 359).

Verbenaceae

Lantana camara

Lantana

Native of tropical South America. A scrambling shrub that often forms dense thickets (Harden, 1992, p.614) and can climb over 20 metres into trees. It grows best on well-drained, fertile soils including nutrient-enriched sands; roots also develop on branches that contact the ground, aiding its spread. It produces abundant seed, which is effectively dispersed by birds. According to Richard Lamb of Sydney University, when Lantana is present, particularly in sclerophyll communities, litter fall and nutrient turnover is altered, populations of native seeds are depleted, new seedlings are suppressed, soil structure is altered and micro-climate is changed, and some nutrients may be mobilized and lost to neighboring communities and others accumulated in unnatural amounts. These changed conditions seem to further favour Lantana and other weeds over native species (Buchanan, 1989, p.72) and in many forest areas can block secondary succession. It is a declared W3 noxious weed (i.e. must be prevented from spreading and its numbers reduced).

VINES AND SCRAMBLERS

Asparagaceae

Protasparagus aethiopicus

Ground Asparagus

Native of South Africa. A shrub with sprawling stems up to two metres long, it is extensively naturalized in coastal districts and is a serious weed of bushland (Harden, 1993, p.46). It will form a total ground cover thereby preventing any germination of native species and inhibiting those that are present. It is a prolific seeder, making eradication difficult.

Protasparagus plumosus

Climbing Asparagus

Vine with wiry climbing stems. Leaves scale-like. Flowers spring and summer but fruits until June. Cultivated as an ornamental but extensively naturalised in coastal districts North of Sydney. A serious weed in bushland that is very difficult to eradicate. Native of South Africa (Harden, 1993, p.46).

Convolvulaceae

Ipomoea cairica

Coastal Morning Glory

Native of tropical Africa and Asia. Perennial with twining and trailing stems. Violet to purplish violet flowers with a darker throat. Flowers throughout the year. Widely cultivated and frequently naturalised in coastal districts (Harden, 1992, p.380).

Ipomoea indica

Blue Morning Glory

Native of tropical regions. A vine which can smother trees and whose stolons can penetrate and establish several metres into native vegetation. It is widely naturalized in coastal districts of northern NSW (Harden, 1992, p.381). Although Harden (1992) states that seed is not set in Australia, fruit and seedlings have been observed at Rotary Park, Lismore, NSW. It is a vigorous vine that will form curtains over support plants thereby reducing photosynthesis and causing limb damage by its foliage weight.

Passifloraceae

Passiflora edulis

Edible Passionfruit

Native of America. A climber that is often naturalized on the edge of rainforest and moist gullies (Harden, 1990, p.434). This plant bears heavy fruit whose seeds are readily dispersed by birds and animals. Its foliage cover inhibits photosynthesis of supporting plants, which can also be damaged by its weight.

Passiflora suberosa

Corky Passionfruit

Native of South America. A slender vine with corky stems occasionally naturalized in disturbed rainforest in warmer areas (Harden, 1990, p.435). Its foliage cover inhibits photosynthesis of supporting plants, which can also be damaged by its weight. Birds and animals disperse its seed.

Passiflora subpeltata

White Passionflower

Native of Brazil. A climber that is a widespread weed along the coast on margins of rainforest and moist gullies (Harden, 1990, p.435). Its foliage cover inhibits photosynthesis of supporting plants, which can also be damaged by its weight. Birds and animals disperse its seed.

Solanaceae

Solanum seafortianum

Climbing Nightshade

Sprawling perennial shrub or climber. Mauve-blue flowers with bright red berries. Flowers chiefly in spring and autumn. Cultivated as an ornamental on moister sites north of Wingham. Native of the West Indies (Harden, 1992, p.357).

HERBS, FERNS AND GRASSES

Asteraceae

Ageratum houstonianum

Blue Billy Goat

Native of Mexico. Common weed of wasteland north of Sydney. Erect or decumbent branched herb, 0.3-1 metre high, coarsely hairy or nearly glabrous. Leaves ovate to triangular, two to seven centimetres long. Margins are regularly toothed and both surfaces have scattered hairs. Florets are blue-mauve (Harden, 1992, p.150).

Gazania rigens

Perennial herb with bright orange to deep yellow flowers with a black base marked with a white dot. Flowers most of the year. Grows on coastal dunes and roadsides. Native of South Africa (Harden, 1992, p.319).

Senecio madagascariensis

Fire Weed

Annual or biennial herb, 20-60 centimetres high, mostly erect, sometimes much branched, glabrous or sparsely hairy. Leaves variable. Flowers chiefly Spring-Autumn. Toxic to cattle and horses if eaten. Native of South Africa (Harden, 1992, p.308).

Dracaenaceae

Sansievera trifasciata

Mother-in-law's Tongue

Plant with a very short stem, strongly stoloniferous. Leaves dark green with light or greyish green bands, margins narrow, light green, yellow or reddish. Commonly cultivated as a pot plant, occasionally naturalised. Native of Africa (Harden, 1993, p.51).

Euphorbiaceae

Euphorbia cyathophora

Painted Spurge

Native of tropical America. An annual, erect herb, flowering most of the year. It is naturalized on coastal sands (Harden, 1990, p.425). It can form dense thickets up to 1.5 metres high (Cribb and Cribb, 1985, p.123) inhibiting native regeneration.

Lamiaceae

***Salvia* sp.**

Salvia

Annual or perennial herbs. Branches covered with simple hairs. Leaves opposite, margins entire. Includes Woolly Sage, Wild Sage and Mintweed (Harden, 1992, p.634).

Phytolaccaceae

Phytolacca octandra

Inkweed

Herb one to two metres high, woody at the base. Stems and flowers green to pinkish. Flowers in spring and summer, fruit red turning to black when ripe. Usually found in moist areas. Native of tropical America (Harden, 1990, p.176).

Poaceae

Cynodon dactylon

Couch Grass

Rhizomatous and/or stoloniferous mat forming perennial, to 0.3 metres high, rooting at the nodes. Flowers mainly in summer. Widely cultivated as a lawn and pasture grass (Harden, 1993, p.522).

Stenotaphrum secundatum

Buffalo Grass

Glabrous, stoloniferous perennial to 0.3 metres high. Flowers in Summer. Grows on the coast but cultivated elsewhere. Native of America and Africa (Harden, 1993, p.541).

Tropaeolaceae

Tropaeolum majus

Nasturtium

Annual herb with branches to about 50 centimetres long. Leaves peltate. Flowers spring and autumn, flowers red, yellow or orange. Fruit indehiscent. Widely cultivated as an ornamental, naturalised in disturbed areas. Native of South America (Harden, 1992, p.32).

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APPENDIX 4: Weed Treatment Methods

1. **“Cut-scrape-paint”**: this method applies to all woody shrubs, trees and some vines.
 - (a) Cut plant low to the ground at an angle.
 - (b) Apply Glyphosate immediately at the rate of 1 part Glyphosate: 1.5 parts water, with a paintbrush approximately 1.5 centimetres wide.
 - (c) Scrape sides lightly to reveal green tissue and apply the herbicide to the scraped area.
 - (d) Take care that the brush is not contaminated with soil.

Note: all seed that has high viability and longevity, e.g. *Senna* spp. and other members of the Fabaceae family, or plants with a high invasive potential, such as *Schefflera actinophylla*, must be removed from the parent and either composted on site or removed from the site.
 2. **“Gouge-paint”**: this method applies to those plant species that have a fleshy root system, such as rhizomes or large bulbs. It is particularly appropriate for the treatment of *Protasparagus* spp. (Asparagus).
 - (a) Gouge out sections of the fleshy base with a knife (if using on Asparagus, first cut the stems at shoulder height and also at the base).
 - (b) Apply 1 part Glyphosate: 1.5 parts water immediately, with a paint brush approximately 1.5 centimetres wide.
 3. **“Stem Injection”**: this method applies to all woody trees and shrubs with a diameter of about six to ten centimetres or greater.
 - (a) With a tomahawk, make a cut the width of the blade, at a slight angle, into the trunk.

Note: it is important not to make cuts too deep.
 - (b) Apply herbicide immediately into the cut using a tree-injecting device (if using Glyphosate, apply at the rate of 1 part Glyphosate: 1.5 parts water).
 - (c) Repeat this procedure in a brickwork pattern around the circumference of the tree, as close to the ground as possible. Where the presence of a crotch angle makes this difficult, make a cut above it. **Note:** two rows of cuts will be sufficient for trees with trunks of six to ten centimetres; larger trunk diameters will need correspondingly more.
 - (d) Treat all visible lateral roots as per (a).
 4. **“Scrape-ditch-paint”**: this method is applicable to many species of vines where it is desirable to treat the vines intact, particularly those with aerial tubers such as *Anredera corifolia* (Madeira Vine) or those which will propagate from segments, e.g. *Delairia odorata* (Cape Ivy).
 - (a) Scrape the stem tissue on one side of the stem only for at least 20-30 centimetres if possible. **Note:** on Madeira Vine, it is necessary to scrape heavily. Scrape as many sections of the stem as possible.
 - (b) Apply undiluted Glyphosate with a paintbrush.
 - (c) On stems that are thicker or horizontal, make a ditch into the stem with a knife and apply herbicide. Tubers and side roots should be treated the same way. **Note:** care must be taken not to sever the stem.
 5. **“Spraying”**: this is carried out using a 15 litre backpack spray unit with a modified spray nozzle that gives a solid spray pattern. Glyphosate is the main herbicide used with the addition of a marker dye. For plants that show some resistance (e.g. Madeira Vine) or where growing conditions are not optimal, an acidifying agent, LI700®, is added. Metsulfuron can also be used for resistant species and grasses. It should be used with a surfactant, such as Agral®.
- Note:** where both Glyphosate and Metsulfuron are recommended for a species, it may be possible to use a commercially available compound of these two herbicides. This approach is currently under trial and is not suitable for operators unskilled in precision spraying.

Note: dilution rates for Glyphosate and Metsulfuron are in accordance with the manufacturer's recommendations and any variation requires a permit from the National Registration Authority.

Dilution Rates (Glyphosate: water):

- Plants with more or less succulent leaves, e.g. *Tradescantia fluminensis*, *Anredera cordifolia* (autumn to winter is the suggested time for spraying these plants), *Chlorophytum* spp. etc.
1 part Glyphosate: 50 parts water + LI700® 0.5%
- *Lantana camara*
1 part Glyphosate: 100 parts water
- Other soft-leaved plants, annuals and grasses
1 part Glyphosate: 100 parts water
- *Chrysanthemoides monilifera* subsp. *rotundata*
1 part Glyphosate: 150 parts water to 1 part Glyphosate: 400 parts water

Dilution Rates (Metsulfuron: water):

- 1.5g Metsulfuron: 10 litres water + 20 millilitres Agral®: 10 litres water

6. **"Overspray"**: this method is applicable to large, dense infestations of such plants as *Chrysanthemoides monilifera* subsp. *rotundata* (Bitou Bush) and *Lantana camara* (Lantana), where it is desirable to leave the dead plants intact to prevent erosion and over-exposure of large areas, protect native seedlings from predators such as wallabies, and avoid trampling by humans.

- (a) Spray over the top of the infestation, using a weak solution of Glyphosate.
Note: any native plants that may be under the weed will be protected by the foliage cover of the weed.
- (b) Leave the sprayed plants intact so that native seedlings can establish under the shelter provided.

Note: Lantana – 1 part Glyphosate: 100 parts water

Bitou Bush – 1 part Glyphosate: 150 parts water to 1 part Glyphosate: 400 parts water

Alternatively: weeds can be cut and flattened with bush-hooks or loppers and the subsequent regrowth sprayed with Glyphosate.

Note: in many cases it is preferable to overspray wherever practicable as this will cause less erosion and trampling of suppressed native plants, such as ferns and seedlings. However, handwork will be necessary to "cut-scrape-paint" any unsprayed Bitou Bush or Lantana that surrounds native plants.

7. **"Crowning"**: this method is applicable to weeds which have their growing points below the surface of the ground (corms, bulbs, rhizomes, clumped or fibrous root systems, etc. e.g. *Protasparagus* spp., *Chlorophytum comosum* and grasses).

- (a) Grasp the leaves or stems and hold them tightly so that the base of the plant is visible. Plants with sharp leaves or stems should be cut back first.
- (b) Insert the knife close to the base of the plant at a slight angle, with the tip well under the root system.
- (c) Cut through the roots close to the base. Depending on the size of the plant, two or more cuts may be needed to sever all the roots.
- (d) Remove the plant. Make sure that the base of the plant where the roots begin is completely removed.

Source: adapted from Joseph, R., 2001. *Course Notes from Certificate II in Bushland Regeneration*. TAFE, Wollongbar.

APPENDIX 5: Treatment Methods for the Weeds at Patches Beach

Scientific Name	Common Name	Control Method
Trees and Shrubs		
<i>Acacia longifolia</i>	Sydney Golden Wattle	Cut-scrape-paint or stem inject 1:1.5 .
<i>Araucaria cunninghamii</i>	Hoop Pine	Stem inject 1:1.5 .
<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>	Bitou Bush	Hand pull young seedlings and hang up. Cut-scrape-paint 1:1.5 small plants. Overspray mature plants if no risk to native seedlings 1:200 .
<i>Cinnamomum camphora</i>	Camphor Laurel	Stem inject 1:1.5 larger trees. Cut-scrape-paint 1:1.5 small plants. Spray seedlings 1:50 + LI700® .
<i>Casuarina equisetifolia</i>	Coastal She Oak	Stem inject 1:1.5 . Do not treat until similar sized trees are established.
<i>Erythrina x sykesii</i>	Coral Tree	Stem inject 1:1.5 . Do not leave cut pieces on the ground.
<i>Eucalyptus torrelliana</i>	Cadagi	Stem inject 1:1.5 .
<i>Lantana camara</i>	Lantana	Lopper and cut-scrape-paint 1:1.5 base. Spray regrowth 1:100 + LI700® .
<i>Leptospermum laevigatum</i>	Coast Tea Tree	Cut close to ground and bag seed.
<i>Opuntia stricta</i>	Prickly Pear	Spray Metsulfuron 1.5g/10L and Agral® 20mL/10L . Bag seed.
<i>Schefflera actinophylla</i>	Umbrella Tree	Hand pull seedlings and bag. Cut-scrape-paint or stem inject 1:1.5 . Cut sections can regrow if left on ground.
<i>Senna pendula</i> var. <i>glabrata</i>	Winter Senna	Hand pull young plants or spray seedlings 1:50 + LI700® . Cut-scrape-paint 1:1.5 . Stem inject large specimens 1:1.5 . Bag seeds.
<i>Senna x floribunda</i>	Smooth Senna	Hand pull young plants. Cut-scrape-paint 1:1.5 . Spray seedlings 1:100 + LI700® . Bag seeds.
<i>Solanum mauritianum</i>	Wild Tobacco Bush	Stem inject 1:1.5 . Some specimens can be left until more natives are present on the site.
<i>Westringia fruticosa</i>	Westringia	Stem inject 1:1.5 .

Scientific Name	Common Name	Control Method
Vines and Scramblers		
<i>Protasparagus aethiopicus</i>	Ground Asparagus	Hand remove (crowning of rhizome). Spray Metsulfuron 1.5g/10L and Agral® 20mL/10L.
<i>Protasparagus plumosus</i>	Climbing Asparagus	Crowning, cut stems at chest height, then at ground level, spray regrowth 1:50 + LI700®.
<i>Ipomoea cairica</i>	Coastal Morning Glory	Hand pull, cut-scrape-paint 1:1.5, roll up vines, spray 1:100 + LI700®.
<i>Ipomoea indica</i>	Blue Morning Glory	Cut-scrape-paint main stem 1:1.5. Hand pull running stolons, roll up and allow to dry out by suspending above ground. Spray small plants and seedlings 1:50 + LI700®.
<i>Passiflora edulis</i>	Edible Passionfruit	Usually hand pull, but if necessary cut-scrape-paint 1:1.5. Roll up vines, spray regrowth 1:100 + LI700®. Bag fruit.
<i>Passiflora suberosa</i>	Corky Passionfruit	Smaller vines can be pulled up and regrowth sprayed. Spray vines scrambling on ground 1:50 + LI700®. Follow large vines carefully to all roots, cut-scrape-paint 1:1.5.
<i>Passiflora subpeltata</i>	White Passionfruit	Hand pull smaller vines, cut-scrape-paint 1:1.5, spray regrowth 1:50 + LI700®.
<i>Solanum seaforthianum</i>	Climbing Nightshade	Hand pull. Best to locate when in flower. If in seed bag fruit.
Herbs, Ferns and Grasses		
<i>Ageratum houstonianum</i>	Blue Billy Goat	Spray 1:100 + LI700®.
<i>Digitaria didactyla</i>	Couch Grass	Spray 1:100 + LI700®.
<i>Euphorbia cyathophora</i>	Painted Spurge	Spray 1:100 + LI700®. Hand pull.
<i>Gazania rigens</i>		Hand pull.
<i>Phytolacca octandra</i>	Inkweed	Hand pull.
<i>Salvia</i> sp.	Salvia	Hand pull.
<i>Sansivera trifasciata</i>	Mother-in-law's Tongue	Spray Metsulfuron 1.5g /10L with Agral® 20mL/10L.
<i>Senecio madagascariensis</i>	Fireweed	Hand pull.
<i>Stenotaphrum secundatum</i>	Buffalo Grass	Spray 1:100 + LI700®.
<i>Tropaeolum majus</i>	Nasturtium	Spray 1:100 + LI700®.

Note: Unless otherwise stated the herbicide recommended for the techniques described above is Glyphosate e.g. Roundup®. LI700® should be used as per manufacturer's instructions. An off label permit is required from the National Registration Authority for any combination of herbicides or for rates not described on the product labels.

APPENDIX 6: Tools and Equipment Required

Non-consumables

- Plastic or steel boxes for equipment storage
- Leather pouches with belts to secure secateurs and knives
- Felco® secateurs (no.5)
- Victorinox® Boning knives with non-slip handles
- Sandvik® loppers (no.16)
- Large bow saw
- Small pruning saws
- Poison pots, stands, and paintbrushes
- Goggles for mixing and applying herbicide
- Tomahawk
- Tree injection unit
- Sharpening stone
- Post hole shovels for tree planting
- Hoses
- Wheel barrow
- Chemical measuring container
- Rubber gloves for measuring and applying herbicide
- Gardening gloves
- 15 litre backpack spray unit with Rega® nozzle
- Fertilizer (or other large) sacks for weed and tuber removal
- Black builders' plastic for composting
- Native plant and weed identification manuals
- Hand lens
- Camera
- First aid kit
- Tarp for laying tools out on when the ground is wet (various other uses i.e. erecting sunshade, rain protection etc.)

Consumables

- Aerosol oil for tool maintenance (WD40® or Inox®)
- Tree fertilizer tablets (Agriform®)
- Diary/ journal
- Work record sheets (see Appendix 7)
- Flagging tape
- Photographic film
- Glyphosate (Roundup®)
- LI700® - acidifier
- Metsulfuron (Brushoff® or Brush Killer®)
- Agral® – surfactant
- Spray marker dye
- Fencing material – timber posts, pig wire, shade cloth
- Trees for planting
- Nitram® – fertiliser
- Water crystals or wetting agent
- Tree guards and/or wallaby repellent spray
- Stakes or star pickets for photo points

APPENDIX 7: Regeneration Record Sheet

REGENERATION RECORD SHEET

Remnant Name:	Date:
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Personnel/Volunteers:	Hours Worked:
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Weather Conditions (temperature, prevailing wind, cloud cover etc.):
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Work Completed (work zone – use map on reverse, methods trialed, comments on previous works, monitoring, follow-up or reminders etc.):
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Weeds Treated	Methods Used	Chemical & Application Rate

Chemical	Vol. Used (ml)	Chemical	Vol. Used (ml)

Payment/Funding	Cheque No.	Invoice No.

Observations (flora, fauna, fruiting, flowering etc.):
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Accidents/Incidents/Near Misses:
