Department for Environment and Heritage

Strategic management of Aleppo Pines on Lower Eyre Peninsula to maximise biodiversity conservation outcomes

Government of South Australia

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Aleppo Pine infestation, Uley Basin, lower Eyre Peninsula, South Australia (Photo: Sarah Way).

Sugar Gum Woodland threatened vegetation community, lower Eyre Peninsula (Photo: Amy Ide).

Yellow-tailed Black-Cockatoo eating a pine cone (Photo: Kari Hoven).

Vulnerable Silver Daisy-bush (Photo: DEH).

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Introduction

This report provides a recommended approach to Aleppo Pine management on lower Eyre Peninsula (EP) to benefit the region's biodiversity. Aleppo Pines are both an environmental weed (proclaimed under the *Natural Resources Management Act 2004*) threatening native vegetation and an important food source for the Critically Endangered Eyre Peninsula Yellow-tailed Black-Cockatoo (EPYTBC). This report aims to balance the competing interests in the control of Aleppo Pines on EP and present management recommendations to achieve maximum biodiversity benefit.

Aleppo Pine site assessments

Two hundred and fifty-three Aleppo Pine sites were surveyed across lower Eyre Peninsula. Over half (58%) of Aleppo Pine sites were identified for control (local eradication) due to negative impacts on biodiversity values (Table 1). Of these, 38% were identified for high priority eradication due to their proximity to threatened flora sites and remnant threatened vegetation communities. Seventeen percent of Aleppo Pine sites surveyed were identified as important EPYTBC feeding sites and/or occurring in the core breeding area (Koppio Hills) and recommended for retention and management (Table 1). The assessments of Aleppo Pine sites in this way aims to focus efforts on those sites posing the most threat to biodiversity values. The assessment suggests a prioritised focus for site control or management rather than an increase or decrease in existing effort by current stakeholders.

Table 1 Number of Aleppo Pine sites in each management category

	Eradication: High priority	**Eradication: Medium priority**	**Eradication: Low priority**	**Retain & Manage**	**Retain: Private**
Number of sites	56	18	72	43	64
% total number of sites	22	7	29	17	25

Aleppo Pines as an EPYTBC food resource

Eyre Peninsula Yellow-tailed Black-Cockatoos are adept feeders on Aleppo Pine cones. In the breeding area, EPYTBCs spend at least 75% of their foraging time feeding on seeds from Aleppo Pine cones (pre-fire data). Risk of terrestrial predation is also reduced while EPYTBCs are feeding in Aleppo Pine.

EPYTBCs display habitual feeding behaviour and have strong site fidelity for particular Aleppo Pine trees, revisiting the same stand and even the same tree every season, both in their breeding area and winter habitat.

EPYTBC nest selection is influenced by the proximity of traditional Aleppo Pine stands. The majority of nests are within 2 kilometres of known feed trees.

A comparison of food availability of native (Wrinkled Hakea, *Hakea rugosa*) and non-native (Aleppo Pine) EPYTBC food resources illustrated that an average size Aleppo Pine (8-10 metres) has over one thousand times more available seed (974,524.4) than one large size hakea bush (718.6). This has important implications for EPYTBC conservation and the replacement of equivalent food resources if known Aleppo Pine feed trees are removed.

It is estimated that **1.77 hectares** of pure hakea revegetation would be required to replace the equivalent available food resource if 10 medium sized Aleppos Pines were removed. This equates to **35.4 hectares** of representative Sugar Gum Woodland direct seeding (with an abundance of 5% hakea per hectare).

Nutritionally, Aleppo Pine seeds are higher in crude fats and have greater total energy content compared to both Wrinkled Hakea and Elm-seed Hakea (*H. cycloptera*), but are harder to digest and considerably lower in calcium. There was no evidence that Aleppo Pine seeds contain any

individual minerals or mineral levels that are toxic to EPYTBCs. The fact that the majority of EPYTBC's diet is Aleppo Pine seed indicates that the resource is critical in supplying the population with its daily energy requirements.

The priorities and recommendations presented in this report are guidelines only. They are presented to assist stakeholders involved in Aleppo Pine management.

Criteria for Aleppo Pine control or retention/management

Aleppo Pine sites are identified for control (local eradication) if:

1. **The site poses a high infestation risk to native vegetation such as high quality roadside remnants, threatened vegetation communities, threatened flora sites, Heritage Agreements, national parks and reserves**, *and*
2. **The site is more than 5 kilometres from the EPYTBC breeding area (identified on map)**, *and*
3. **There are no records of EPYTBC feeding at the site within the last 10 years**, *or*
4. **The site was 100% burnt during the January 2005 bushfire.**

Aleppo Pine sites are recommended for retention and management if:

1. **The site occurs in or within 5 kilometres of the EPYTBC breeding area**, *or*
2. **EPYTBC have been recorded feeding at the site within the last 10 years AND the site poses a minimum infestation risk to native vegetation such as high quality roadside remnants, threatened vegetation communities, threatened flora sites, Heritage Agreements, national parks and reserves**, *or*
3. **The site is on private land and poses a minimum infestation risk to biodiversity values.**

Guidelines for management

GUIDELINE 1

Locally eradicate pines at sites west of the designated boundary (excluding EPYTBC feed trees at SA Water Uley Basin and Duckponds), especially at:

1. Coulta

2. Kellidie Bay

3. Sleaford

as a first priority to protect high biodiversity values, large remnant areas and Reserves (Refer to Map 4).

GUIDELINE 2

When revegetating Aleppo Pine control sites, use indigenous species endemic to that area. When removing Aleppo Pines from areas with EPYTBC feeding records (more than 10 years old), ensure that revegetation occurs with a significant proportion of EPYTBC native food species such as:

- Wrinkled Hakea (*Hakea rugosa*)

- Elm-seed Hakea (*H. cycloptera*)

- Sugar Gum (*Eucalyptus cladocalyx*)

- Drooping Sheoak (*Allocasuarina verticillata*)

- Yacca (*Xanthorrhoea semiplana*),

in areas where these species are locally indigenous.

GUIDELINE 3

Where possible, commence pine eradication at sites located as far as possible from the EPYTBC breeding area and known feeding sites.

(Refer to EPYTBC breeding area and buffer as shaded in Map 4).

GUIDELINE 4

Retain and manage all unburnt Aleppo Pines within the EPYTBC breeding area and within 5 kilometres of the EPYTBC breeding area.

(Refer to EPYTBC breeding area and buffer as shaded in Map 4).

1 INTRODUCTION

This report provides:

1. A recommended approach to Aleppo Pine management on lower Eyre Peninsula (EP), South Australia, for the maximum benefit of the region's biodiversity.
2. Practical guidelines for use by stakeholders involved in Aleppo Pine management.
3. A document to foster understanding of the importance of Aleppo Pines in the conservation of Yellow-tailed Black-Cockatoos on Eyre Peninsula.
4. A complement to other documents concerning Aleppo Pine management on lower EP including:
    - Ancell, D 2004, *General principles and priorities for biodiversity conservation in the Eyre Peninsula NRM region*, Eyre Peninsula Natural Resource Management Group, Port Lincoln.
    - EAC 2004, *Vegetation Management Plan for Wanilla Forest*, a report prepared by EAC – Ecological Evaluation for Port Lincoln Aboriginal Community Council and Threatened Species Network SA.
    - Quarmby, JP 2004, *Aleppo Pine survey of Uley Wanilla, Uley South and Lincoln Basins: report on the distribution and abundance of Aleppo Pine and recommendations for control*, SA Water Corporation.
    - *Map series of Aleppo Pine roadside infestations on Lower Eyre Peninsula*. Available from the Eyre Peninsula Natural Resources Management Board (EPNRM) (formerly the Southern Eyre Animal and Plant Control Board).

The eradication of an environmental weed such as the Aleppo Pine on EP is not a straightforward matter. Local eradication at a site-by-site priority basis, however, is achievable. Aleppo Pines are both an environmental weed (proclaimed under the *Natural Resources Management Act 2004*) threatening native vegetation and an important food source for the Critically Endangered Eyre Peninsula Yellow-tailed Black-Cockatoo (EPYTBC). When determining an approach to Aleppo Pine management on EP, many issues need to be considered, including:

- impact on biodiversity
- 'best practice' weed management
- varying degrees of infestation and the large area affected
- relationships with other biodiversity values
- varying community attitudes towards Aleppo Pines
- constraints on time, money and resources available for management.

2 THE ALEPPO PINE ON EYRE PENINSULA

2.1 Ecology

The Aleppo Pine (*Pinus halepensis* Mill.) is a large (25-30 metre) coniferous species from the Mediterranean (Figure 1). Its natural distribution extends from Morocco in the west to Jordan in the east, and from France in the north to Palestine in the south. Aleppo Pines have serotinus cones, that is, seeds are produced, stored and protected in the canopy. Cones take three seasons to mature and the viability of canopy-stored seed can be maintained for as long as 20-50 years (Daskalakou and Thanos 1996).

Figure 1 Aleppo Pine (*Pinus halepensis*) (Photo: Jason van Weenan)

Aleppo Pine cones open and release seed in response to disturbance (e.g. fire and being felled) and their permanent, long-term seed bank is a key feature for post fire regeneration. Aleppo Pines are prolific seeders. Research in Greece estimated Aleppo Pines could produce an annual seed rain (dispersed in fire-free conditions) of between 25-105 seeds per square metre (Daskalakou and Thanos 1996) or 17,400 seeds per year for mature trees (Virtue and Melland 1999). This makes control particularly difficult and follow up management is crucial to control mass germination and seedling growth.

Aleppo Pine seeds are wind dispersed and can carry for considerable distances on prevailing winds, however the majority of seeds fall to within 40-50 metres of the parent tree (Bulman 1992). Soil seed-banks are significantly short-lived compared to canopy storage. Germinable seed content in the soil has been shown to rapidly deplete following the first rainy season (Daskalakou and Thanos 1996).

The species is particularly robust and can quickly re-shoot from the smallest piece of foliage missed during control operations. Herbicides such as 'Brushoff' and 'Trounce' (Ally plus Glyphosate) have also proven ineffective.

2.2 History and distribution on Eyre Peninsula

Aleppo Pines were introduced to Eyre Peninsula by the forestry industry in the early 1800s. Aleppo Pines grew quickly and responded well to Eyre Peninsula's calcareous soils and Mediterranean climate (annual rainfall of 300-600 mm). Being quite a large and fast-growing species, Aleppo Pines proved ideal for windbreaks around farmhouses and buildings, as well as stock shelterbelts. Consequently, Aleppo Pines were widely planted on lower EP by early settlers and later throughout the soldier settlements after World War II. Aleppo Pines were still recommended for this purpose by the Department for Agriculture up until the mid 1980s.

In South Australia, naturalised populations of Aleppo Pines exist throughout lower Eyre Peninsula, parts of Yorke Peninsula and the southern Mount Lofty region. On lower Eyre Peninsula, severe infestations of Aleppo Pines occur along Flinders Highway and many roadside reserves, Uley Wanilla, Uley South and Lincoln Basins (SA Water Corporation) and Kellidie Bay Conservation Park (Department for Environment and Heritage).

2.3 Implications for biodiversity conservation

2.3.1 Native vegetation and threatened flora

The invasiveness of the Aleppo Pine in Australian bushland is well documented (Virtue and Melland 1999, Csurches and Edwards 1998, Richardson *et al*. 1994 and Robertson 1994) and directly threatens some biodiversity values. The fast growing Aleppo Pine seedling can readily establish in areas of native vegetation, out-competing and inhibiting the germination of native plants. Some pine infestations can be so thick that shading and oil from the pine needles inhibits the growth of other plants, causing a decline in many native plant species, associated fauna and their habitats.

Many Aleppo Pine infestations on lower Eyre Peninsula occur along roadsides, having originated from shelterbelts along driveways or paddocks adjacent to roads. Several of Eyre Peninsula's threatened flora species have significant remnant populations persisting along roadsides, e.g. Prickly Raspwort (*Haloragis eyreana*, Nationally Endangered), Silver Daisy-bush (*Olearia pannosa* subsp. *pannosa*, Nationally Vulnerable), Fat-leaf Wattle (*Acacia pinguifolia*, Nationally Endangered) and Metallic Sun-orchid (*Thelymitra epipactoides*, Nationally Endangered) (Freebairn 2003) and are highly vulnerable to being out-competed by pine infestations.

In addition, the Nationally Vulnerable Winter Spider-orchid (*Caladenia brumalis*), Ironstone Mulla Mulla (*Ptilotus beckerianus*) and Tufted Bush-pea (*Pultenaea trichophylla*) often persist in roadside remnants and are at risk from Aleppo Pine infestations (K Pobke [Department for Environment and Heritage] 2006, pers. comm.).

Aleppo Pines also compromise the quality and habitat value of native vegetation, whether it is roadside remnants, conservation reserves, national parks or remnants on private land (e.g. Heritage Agreements). These remnants provide important habitat for native fauna utilising the fragmented landscape of lower Eyre Peninsula.

2.3.2 Interactions with native fauna

As well as negatively impacting on floristic biodiversity, Aleppo Pines are crucial for the survival of the Critically Endangered Eyre Peninsula Yellow-tailed Black-Cockatoo (*Calyptorhynchus funereus*), (EPYTBC). Aleppo Pines provide a critical food resource for EPYTBC following large-scale loss of the cockatoos' Sugar Gum (*Eucalyptus cladocalyx*) Woodland habitat throughout Eyre Peninsula since European settlement (see Section 3).

This relationship is one of a number of cases where threatened species utilise introduced plants in response to loss of native resources and habitat. The Nationally Endangered Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) feed on Radiata Pines (*Pinus radiata*) in Western Australia, while Southern Brown Bandicoots (*Isoodon obesulus*) and Southern Emu-wrens (*Stipiturus malachurus*) are known to utilise Blackberry thickets and Gorse for cover and protection (Richardson 2003, Environment Australia 1998).

Introduced plant species may provide supplementary habitat for some native species that have adapted to an environment modified by humans. For example, Port Lincoln Parrots (*Barnardius zonarius*) also feed on Aleppo Pine cones and other species such as the Australian Kestrel (*Falco cenchroides*), Nankeen Night Heron (*Nycticorax caledonicus*) and Brown Goshawk (*Accipiter fasciatus*) have been observed roosting and consuming prey in Aleppo Pines (S Way [Department for Environment and Heritage], pers. obs.). However, for species more sensitive to habitat modification, Aleppo Pine infestations pose a serious threat to both the structure and function of those species' native habitats. Species such as the Western Pygmy Possum (*Cercartetus concinnus*), Common Brushtail Possum (*Trichosurus vulpecula*), Diamond Firetail (*Stagonopleura guttata*) and many other woodland birds and reptiles are particularly vulnerable to the impacts of Aleppo Pines.

3 EYRE PENINSULA YELLOW-TAILED BLACK-COCKATOO

3.1 Conservation status and distribution

Yellow-tailed Black-Cockatoos (YTBC) (*Calyptorhynchus funereus*) are classified as Vulnerable under Schedule 8 of the South Australian *National Parks and Wildlife Act 1972* (NPW Act). Yellow-tailed Black-Cockatoos have experienced a historical population decline over the last several decades and habitat loss, with its associated effects, is believed to be the principal cause. Lower Eyre Peninsula has experienced high levels of native vegetation loss associated with agriculture, with the native vegetation remaining at between 7 and 15% of total land area (DEH Biodiversity Assessment Services internal document, 1997). Large areas of heathland vegetation communities, and heathy Sugar Gum Woodland habitats, containing EPYTBC food plants and large hollow-bearing trees for nest sites have been lost from EP since European settlement (Figure 2).

The Eyre Peninsula population of *Calyptorhynchus funereus* is Critically Endangered. Recovery actions over the last seven years have increased EPYTBC numbers from as low as 19 birds in 1997 to the pre-2005 estimate of between 30 and 34 individuals. There were eight, possibly nine, breeding pairs before the Wangary fire of January 2005. The number of EPYTBCs that may have perished in the fire is still not known and may never be confirmed. What is known is that 23 individual EPYTBCs have been observed since the January 2005 fire. In the 2005-2006 breeding season only 12 individuals were recorded in the breeding area including four or possibly five breeding pairs. It is possible that only one chick successfully fledged in the 2006 season.

Eyre Peninsula Yellow-tailed Black-Cockatoos spend the winter on north-west Eyre Peninsula, inland from Venus Bay near Wootoona, Mount Damper and Mount Cooper (Figure 3). In this area, the EPYTBCs predominately feed on Aleppo Pines on farming land (as in the south) or wood boring insects in mallee vegetation from Kulliparu Conservation Park, where they also roost. There is still more to be learnt about the birds' distribution in their northern range, as well as their migration route. The northern extent of EPYTBCs on EP was believed to be Streaky Bay, however, unconfirmed observations of birds near Ceduna in 2004 and 2005 could expand the boundary of their northern range by approximately 120 kilometres.

From early October, Eyre Peninsula Yellow-tailed Black-Cockatoos begin their migration south to the Koppio Hills and Wanilla areas where they breed in Sugar Gum Woodland remnants on private farmland (Figure 3, Map 1). The breeding birds remain in this area during summer before returning to their northern range in late April or early May. Whilst in the southern part of their range, a group of non-breeding birds spend most of the summer out of the breeding area, possibly in the Uley Wanilla Basin and/or Wanilla Forest.

Figure 2 Remnant and Cleared Native Vegetation Communities of Lower Eyre Peninsula

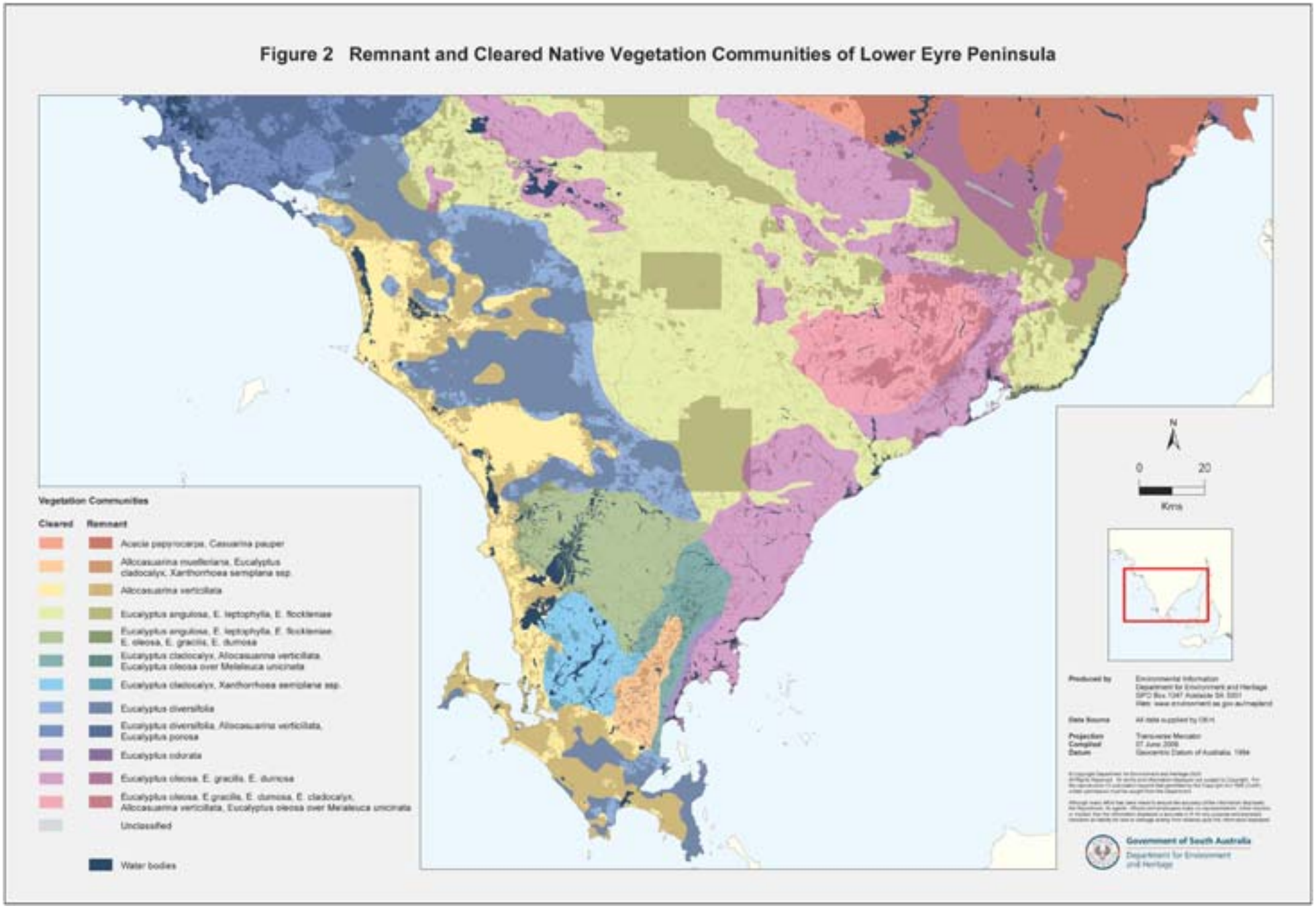
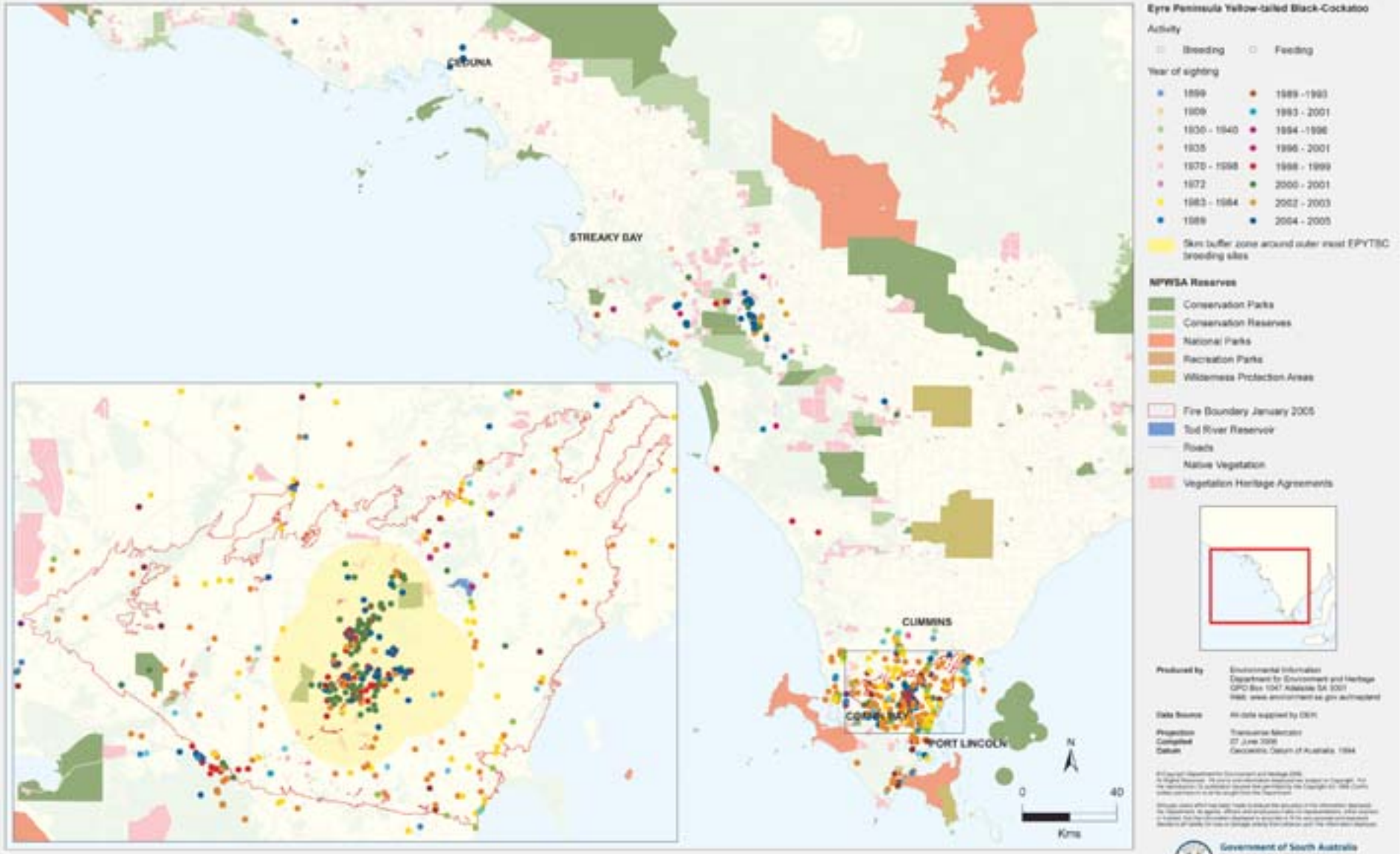


Figure 3 Eyre Peninsula Yellow-tailed Black-Cockatoo Distribution, Eyre Peninsula



3.2 The EPYTBC Habitat Recovery Project

The EPYTBC Habitat Recovery Project began in 1998. Key actions include:

- nest monitoring during the breeding season (November to March) to measure breeding success and recruitment
- location and protection of new nests from the Common Brushtail Possum (*Trichorsurus vulpecula*) predation (another threatened species in the region)
- monitoring nestling growth with chicks banded just before fledging
- population census and collecting re-sight data of banded birds
- recording behavioural observations, including habitat use and feeding behaviour
- mapping habitat, nest sites and distribution across EP
- locating and mapping Aleppo Pine feed trees
- protecting critical habitat remnants through voluntary Land Management Agreements and fencing
- revegetation of Sugar Gum Woodland species, including EPYTBC native food species. There has been a specific focus to increase the amount of the EPYTBC's main native food, the Wrinkled Hakea (*Hakea rugosa*), and many thousands of tubestock have been planted at over 20 sites in the breeding area since 1998
- continuation of fostering community awareness and participation in recovery efforts.

3.3 Diet

Eyre Peninsula Yellow-tailed Black-Cockatoos consume a mixture of native and introduced seeds and wood-boring invertebrate larvae including:

- seeds from the cones of the native Wrinkled Hakea (*Hakea rugosa*) and Elm-seed Hakea (*H. cycloptera*) (Figure 4)
- seeds from the introduced Aleppo Pine (Figure 4)
- burrowing larvae from the moth *Meyriccia latro* within Yacca (*Xanthorrhoea semiplana*) flower spikes (Figure 5)
- insect larvae within Golden Wattle (*Acacia pycnantha*) galls
- wood boring insect larvae found beneath the bark of Drooping Sheoak (*Allocasuarina verticillata*) and several species of eucalypts including Sugar Gum, White Mallee (Yorrel) *(E. gracilis*), Yellow Mallee (*E. incrassata*) and Coastal Mallee (*E. diversifolia*).

Figure 4 EPYTBC food resources, from left to right, seeds from Elm-seed Hakea, Wrinkled Hakea and Aleppo Pine (Photo: Sarah Way)

Figure 5 *Meyriccia latro* moth larvae collected from Yacca flower spikes (Photo: Sarah Way)

Although YTBCs on Kangaroo Island and in the Adelaide Hills forage on Radiata Pine (*Pinus radiata*), the EPYTBC has neither been observed feeding on this species, nor on the native Southern Cyprus Pine (*Callitris preisii*) or the White Cypress Pine (*Callitris glaucophylla*).

Eyre Peninsula Yellow-tailed Black-Cockatoos have responded to the drastic reduction in native food resources by utilising Aleppo Pines. Failure to adapt to alternative food resources such as the Aleppo Pine would have likely resulted in the species' extinction on EP. This is supported by anecdotal evidence that suggests the Glossy Black-Cockatoo once occurred on lower EP, but its highly specialised diet of Drooping Sheoak (*Allocasuarina verticillata*) cones may have impeded its ability to adapt to such rapid changes in food resource availability.

3.4 Foraging ecology

3.4.1 Habitual feeding behaviour and site fidelity

Eyre Peninsula Yellow-tailed Black-Cockatoos display habitual feeding behaviour and have strong site fidelity for key habitat components such as watering points, food resources, nest trees and roosting sites. Traditional Aleppo feeding sites have been identified throughout breeding and non-breeding habitats. Each season, EPYTBCs return to these habitual pine stands in both the over-wintering and summer breeding habitats to feed (refer to Map 1 for EPYTBC Aleppo Pine feeding sites).

So habitual are EPYTBC's feeding patterns that alternative food resources (both Aleppo Pines and native foods) may not always be found and/or utilised. During poorer and/or drought years when traditional feeding sites do not produce enough food, breeding pairs have lost chicks to starvation. Nest attendance rates drop the further birds have to travel to the next nearest known food resource, despite alternative but 'unknown' sites occurring nearby.

3.4.2 Learnt behaviour

Juvenile birds stay with their parents until the start of the next breeding season and sometimes until the following breeding season. During this time the young birds learn many important survival skills and behaviours, including the location of reliable feeding sites.

3.4.3 Predation

Both individuals in a breeding pair have been observed foraging together in Aleppo Pines, however whilst feeding in hakeas, the male may act as sentinel to guard the female against terrestrial predators such as foxes and cats. As both parents take part in feeding both at nestling and fledgling stages, any missed foraging sessions may disadvantage the chick's development.

Some hakea and Yacca plants occur in roadside vegetation, where vehicle strike is a potential hazard.

3.4.4 Nest selection

Nest selection is influenced by the location of habituated food resources and habitual nesting behaviour. A close and reliable food resource is critical to a breeding pair's success in raising their chick. All active nests located in the 2003-2004 breeding season were within at least 2 kilometres of a habituated Aleppo Pine food tree (S Way [Department for Environment and Heritage], pers. obs.).

3.4.5 Aleppo Pines as an EPYTBC food resource

Field observations of EPYTBC feeding behaviour conducted since 1999 have identified the following:

1. The EPYTBCs are highly adapted to forage on immature and un-opened Aleppo Pine cones. Dextrous use of their toes, beak and tongue allows the EPYTBC to efficiently strip seeds from the cone. The birds also extract each seed from the wing and discard the wing.
2. Field studies conducted throughout the late 1990s show that EPYTBCs spend at least 75% of all foraging time feeding on seeds from Aleppo Pine cones in the breeding area (van Weenen and Cooper 2000). More recent pre-fire observations suggest that this figure may be as high as 85-90% for some breeding pairs (J Cooper, pers. comm.). Although not quantified, observations of the birds' foraging behaviour in their winter habitat suggests similar dependence on Aleppo Pines as a major food resource.
3. During the breeding season, both individuals of a breeding pair have been observed foraging on Aleppo Pines together, suggesting a reduction in sentinel behaviour and more efficient foraging trips.
4. Aleppo Pine foraging visits can last over 4 hours and EPYTBCs can generally consume the seeds from eight pine cones in 1 hour. Some birds have been observed consuming the average number of 235 seeds per cone (see Table 4, Section 4.2.2) in 2-3 minutes. If eight cones can generally be consumed in an undisturbed 1 hour foraging visit, this equates to potentially 3,760 seeds consumed by the breeding pair. This compares to 15 hakea cones being taken (or 30 hakea seeds) in 30 minutes by the female only, as the male generally keeps guard (J Cooper, pers. comm.).
5. Selection occurs both within and between stands of Aleppo Pines in both the summer and winter habitats. Differences in the structural form of Aleppo Pine utilised have been noted. In the northern habitat, spindly, individual trees as short as 2-3 metres have been used, while pines selected in the breeding area tend to be large (at least 6 metres high), full-bodied trees.
6. Eyre Peninsula Yellow-tailed Black-Cockatoos leave behind obvious feeding signs in the form of characteristically chewed cones that are dropped around the base of the tree (Figure 6).

(Jane Cooper, past project officer, EPYTBC Recovery Team and local ornithologist, pers. obs. and unpublished data).

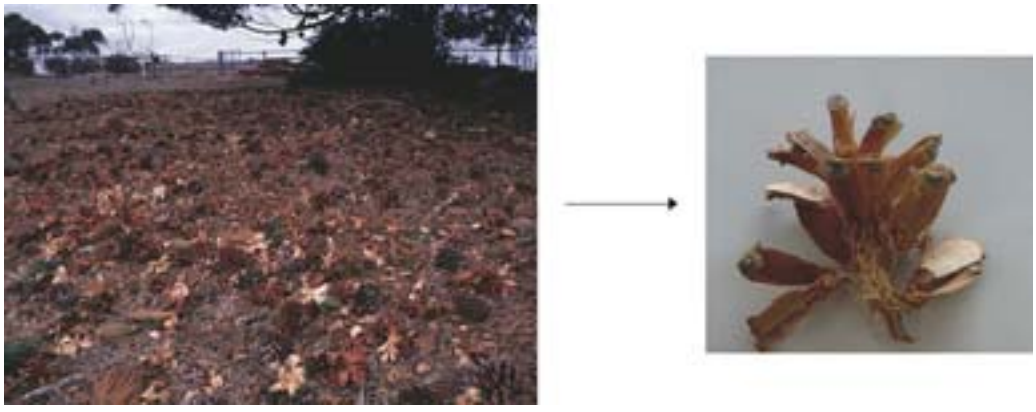


Figure 6 Chewed Aleppo Pine cones, characteristic feeding signs of EPYTBCs (Photos: Jason van Weenen and Sarah Way)

4 QUANTITATIVE AND QUALITATIVE ANALYSIS OF EPYTBC FOOD RESOURCES

Both the nutritional content (quality) as well as the numbers of seeds per cone (quantity) are important considerations when comparing native and introduced EPYTBC food species.

To further understand EPYTBC feeding ecology, preliminary research was conducted to compare the nutritional quality, in terms of EPYTBC dietary requirements, of three main types of EPYTBC food.

To approximate the amount of available food resource Aleppo Pines represent for the YTBC on Eyre Peninsula, a preliminary quantitative analysis was conducted to investigate the number of seeds per cone and cones per plant on Wrinkled Hakea and Aleppo Pine. The aim of this type of quantitative analysis is:

1. To contribute further to the management challenges of EPYTBC conservation and Aleppo Pine control by describing these two resources in terms of their equivalent EPYTBC food availability.
2. To estimate the amount of native vegetation needed to replace the food resources available from one Aleppo Pine EPYTBC feed tree.

4.1 Quality: Nutritional analysis

4.1.1 Methods

The nutritional content of three main food species of EPYTBC was investigated:

- Wrinkled Hakea (*Hakea rugosa*)
- Elm-seed Hakea (*Hakea cycloptera*)
- Aleppo Pine (*Pinus halepensis*).

Limited funds meant that it was not possible to compare differences either within or between these three species at different sites.

One hundred grams of each type of seed were collected. Immature, un-opened cones were sampled from known or historical EPYTBC feeding sites. The cones were placed in a hot-house until they opened. Seeds were then collected and the seed wings were removed. Wings were removed as the birds also remove the wing when foraging and only consume the seed (see Section 3.4.5).

Both species of hakea were collected from in and around the EPYTBC breeding area. The same drying and manual de-winging procedure undertaken for Aleppo Pines was followed for the hakeas. Seeds were kept refrigerated at approximately 4°C before a total 100 gram sample was ready to be sent away for analysis.

The Nutritional Research Laboratory of the Pig and Poultry Production Institute, South Australian Research and Development Institute, conducted nutritional analysis.

De-husking of all seed was performed by roller milling at the Nutritional Research Laboratory prior to analysis. The following analyses were conducted:

- Gross Energy (MJ/Kg) [1]
- Crude Fat (%)
- Ash (%): total mineral content of the food
- Total Starch (%)
- Dry Matter (%): refers to the amount of food available after water has been removed
- Crude Protein (% of dry matter)
- Acid Detergent Fibre (ADF) (% of dry matter): measures digestibility by estimating the cellulose and lignin (indigestible carbohydrate) content in the seed. High levels of cellulose and lignin means lower digestibility

1 MJ stands for mega joule, a unit of energy

- Metabolisable Energy (ME) (MJ/kg of dry matter): the energy actually used by the animal. ME values can be used to calculate whether the animal is receiving adequate energy for maintenance
- Amino acid profiles
- Mineral analysis.

4.1.2 Results

All nutritional data are shown in Appendix 1.

Energy and fats

All three food plant species of seed are relatively high in fats rather than starches (Table 2). This indicates that EPYTBCs, unlike the majority of other seed-eating birds, obtain their energy from fats (T Gliester [Vetafarm], pers. comm.).

Aleppo Pine seeds have a higher gross (total) energy content compared to both species of hakea. Percentage crude fat in Aleppo Pine seeds is over double that for Wrinkled Hakea and noticeably higher than that of Elm-seed Hakea (Table 2).

Table 2 Energetics of three main EPYTBC food resources

	Gross Energy (MJ/Kg)	Crude Fat (%)	Ash (Total mineral content) (%)	Total Starch (%)
Aleppo Pine	25.74	34.08	7.73	1.3
Wrinkled Hakea	19.07	12.27	7.88	1.1
Elm-seed Hakea	21.12	19.89	6.51	0.38

Protein and digestibility

Compared to other seeds used in the manufacturing of cockatoo aviary foods, the protein content of the two hakea species is very high (Table 3). The usual protein content achieved in farmed food plants is 34% (T Gliester [Vetafarm], pers. comm.).

With an Acid Detergent Fibre of 58.7%, Aleppo Pine seeds are harder to digest compared with both species of hakea (Table 3). Digestibility is an important property of any food resource, as it can influence the speed at which food passes through the digestive system and hence impact effective digestion and also influence weight gain and loss.

Table 3 Protein and digestibility of EPYTBC food resources

	Dry Matter (%)	Crude Protein (% of dry matter)	ADF (% of dry matter)	ME (MJ/kg DM)
Aleppo Pine	93.8	24.8	58.7	12.6
Wrinkled Hakea	90.8	64.6	27.2	12.6
Elm-seed Hakea	91.6	47.9	37.6	13.5

Amino acids and minerals

The amino acid and mineral profiles are shown in Appendix 1. The most important things to note include:

- Methionine is quite high in the Aleppo Pine (0.62%) and quite low in both hakeas (0.24% for Wrinkled Hakea and 0.32% for Elm-seed Hakea). Methionine is the first amino acid in every

protein molecule, therefore if it is limited, an animal cannot synthesise proteins. Animal protein, such as insect material in the form of *Meyriccia latro* moth larvae would boost the level of methionine in the EPYTBC diet and would be particularly important if the birds are feeding mostly on hakea species.

- All three seed types have relatively good amino acid levels (T Gliester [Vetafarm], pers. comm.).
- Generally, healthy calcium to phosphorus ratios are recognised as 1:1 or 2:1. Aleppo Pine seeds have a calcium to phosphorus ratio of 1:5. The ratios of the hakea seeds are better balanced, with a calcium to phosphorus ratio of 1:1 for Wrinkled Hakea and 1:2 for Elm-seed Hakea. The correct balance of calcium and phosphorus is vital for many bodily functions and the excessive intake of one mineral (e.g. phosphorous in the Aleppo Pine) may cause a deficiency in calcium, depending on the ratio intake of the different seeds.
- In addition to the high calcium to phosphorus ratio, the low level of calcium in all three seeds, but particularly in the Aleppo Pine (1560 mg/kg) is of potential concern. Growing chicks require about 1% calcium in their diet (T Gliester [Vetafarm], pers. comm.). Coupled with a high fat content, which can reduce available calcium through sequestration (or "soaping") in the gut, a diet high in Aleppo Pine seeds may lead to calcium deficiency.

4.2 Quantitative analysis: Estimating cone abundance and number of seeds

The quantitative analysis presented in this report is intended as a preliminary investigation. The data should be interpreted as a guide to the differences between hakea and Aleppo Pines in abundance of seeds per plant. The method (outlined below) used to estimate Aleppo cone abundance is one of many approaches that may have been applied. Assumptions and qualifiers relating to the data and data collection are outlined where required.

4.2.1 Methods

Aleppo Pines

Three Aleppo Pines were chosen from three sites on Lower EP (n = 9). Three height categories were represented across the three sites, one pine sampled from each category: 6-8 m, 8-10 m and 10-12 m. The sites were chosen to represent different soil types and are listed below:

- SA Water, Uley Wanilla Basin, Big Swamp Road (Calcrete)
- the Pines Picnic Area, Flinders Highway (Ironstone)
- Port Lincoln Golf Course, Flinders Highway (Granitic).

All cones on one major branch approximately half way up the tree were counted with the aid of binoculars (Bushnell 8x40) and a manual telecounter. The number of primary branches was also counted. Based on field observations, it was assumed that the majority of new cone production primarily occurs in the upper two thirds of the tree. To account for this and estimate the total number of cones for the tree, the number of cones counted from the selected branch was multiplied by two thirds of the total number of branches.

The morphology of pine cones is such that two seeds are produced for each individual scale. The number of scales from five Aleppo Pine cones (n = 5) collected from the Pines Picnic Area was counted to estimate the mean number of seeds per cone.

Calculations were made as followed:

Mean number of seeds per cone = 2 x (Number of scales per cone)

Mean number of seeds per tree = Mean number cones per tree x Mean number seeds per cone

Wrinkled Hakea

It was possible to obtain total cone counts from hakea plants. Three plants from two size classes (n=6) were investigated at two sites:

- roadside vegetation remnant, Flinders Highway
- revegetation, Charlton Gully Road.

The hakeas sampled at the revegetation site were in the small size class (<1 m height and <15 cm basal stem diameter) and the hakeas from the roadside vegetation represented the large size class (>1 m height, >15 cm basal stem diameter). The total number of cones was counted for each hakea sampled.

Hakeas produce two seeds per cone, therefore the total number of seeds per hakea bush was calculated as follows:

Number of seeds per hakea bush = 2 X (Number of cones)

4.2.2 Results

Aleppo Pines

The average number of Aleppo Pine seeds per cone is 234.8 (Table 4).

The mean number of Aleppo cones and seeds per tree in each height category is shown in Table 5 and Figures 7 and 8. Raw data of Aleppo Pine cone counts per tree are shown in Table A2.1 in Appendix 2.

Table 4 The mean number of Aleppo seeds per cone

Cone	No. scales	No. seeds
1	106	212
2	105	210
3	107	214
4	147	292
5	123	246
AVERAGE	**117.6**	**234.8**

Table 5 Mean number of Aleppo Pine cones and seeds per tree

Height category (m)	Mean no. cones/tree	Mean no. seeds/tree
6-8	2,985.8	701,060.6
8-10	4,150.4	974,524.4
10-12	6,936.7	1,628,729.3

Wrinkled Hakeas

The mean number of hakea cones and seeds per plant in each height category is shown in Table 6 and Figures 9 and 10. Raw data of hakea cone counts are shown in Table A2.2 in Appendix 2.

Table 6 Mean number of Hakea cones and seeds per plant

Height category (m)	Mean no. cones/plant	Mean no. seeds/plant
<1	115.3	230.6
>1	359.3	718.6

Comparisons

A small Aleppo Pine (6-8 m) has over 25 times the amount of cones compared to a large hakea (Tables 5 and 6). An average size Aleppo Pine (8-10 m) has over 1000 times more seed in the top two thirds of its branches (974,524.4) than a whole large size hakea bush (718.6) (Tables 5 and 6 and Figures 8 and 10). The scale of these differences is not surprising considering the drastic size differences between the two study species, which is apparent even when comparing a small (6-8 m) Aleppo Pine and a large hakea.

While not all of these estimated 2,985 cones on a 6-8 m Aleppo Pine will be available simultaneously as EPYTBC food, it is clear that food resource availability in sexually mature Aleppo Pines far exceeds that of a hakea at any one time. Most pine species take between 7 and 15 years to produce viable seed (Richardson et al., 1990), although EPYTBCs have been observed feeding on the immature cones of young trees.

It should also be noted that cone production on both Aleppo Pines and Hakeas reduces greatly when other vegetation shades the plant. For example, Hakeas growing in shaded woodland habitats are likely to be less productive than those in full sun. The Hakea sites detailed in Section 4.2.1 present data from plants with cone production representative of sunny habitats with minimal shade.

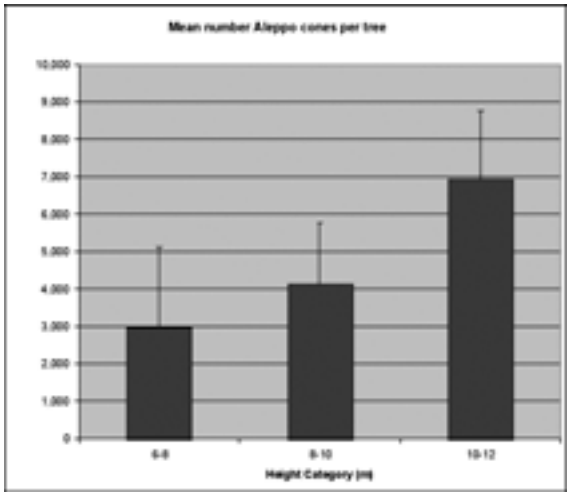


Figure 7 Mean Aleppo Pine cones per tree

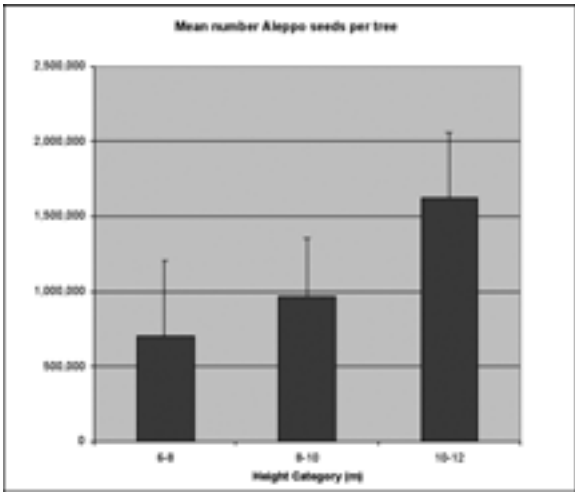


Figure 8 Mean Aleppo Pine seeds per tree

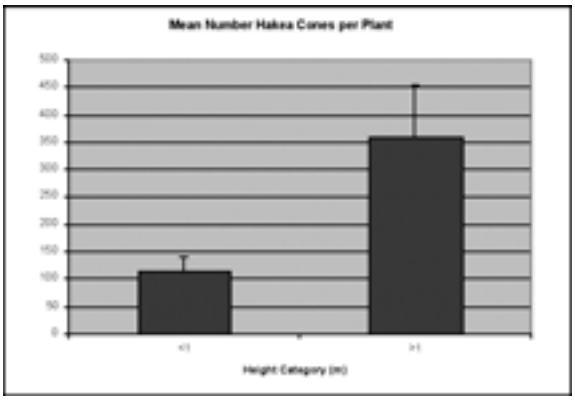


Figure 9 Mean Hakea cones per plant

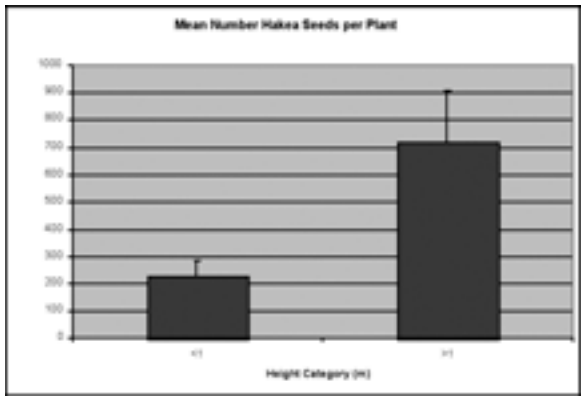


Figure 10 Mean Hakea seeds per plant

5 CONE ABUNDANCE AND IMPLICATIONS FOR REVEGETATION

5.1 Aleppo Pine and hakea food resource equivalence: Revegetation scenario

One small Aleppo (height category 6-8 metres) has a mean of 701,060.6 seeds (Table 5).

One large hakea (height category greater than1 metre) has a mean of 718.6 seeds (Table 6).

Therefore:

975.6 (701,060.6/718.6) large category (>1 metre height) hakeas are needed to provide the equivalent numbers of seed of one small (6-8 metre) Aleppo Pine.

If an Aleppo Pine proposed for removal is utilised by EPYTBCs, this above figure illustrates the scale of food resource loss and has clear implications for attempts at replacing this resource with revegetation.

What does this mean for revegetation?

Scenario

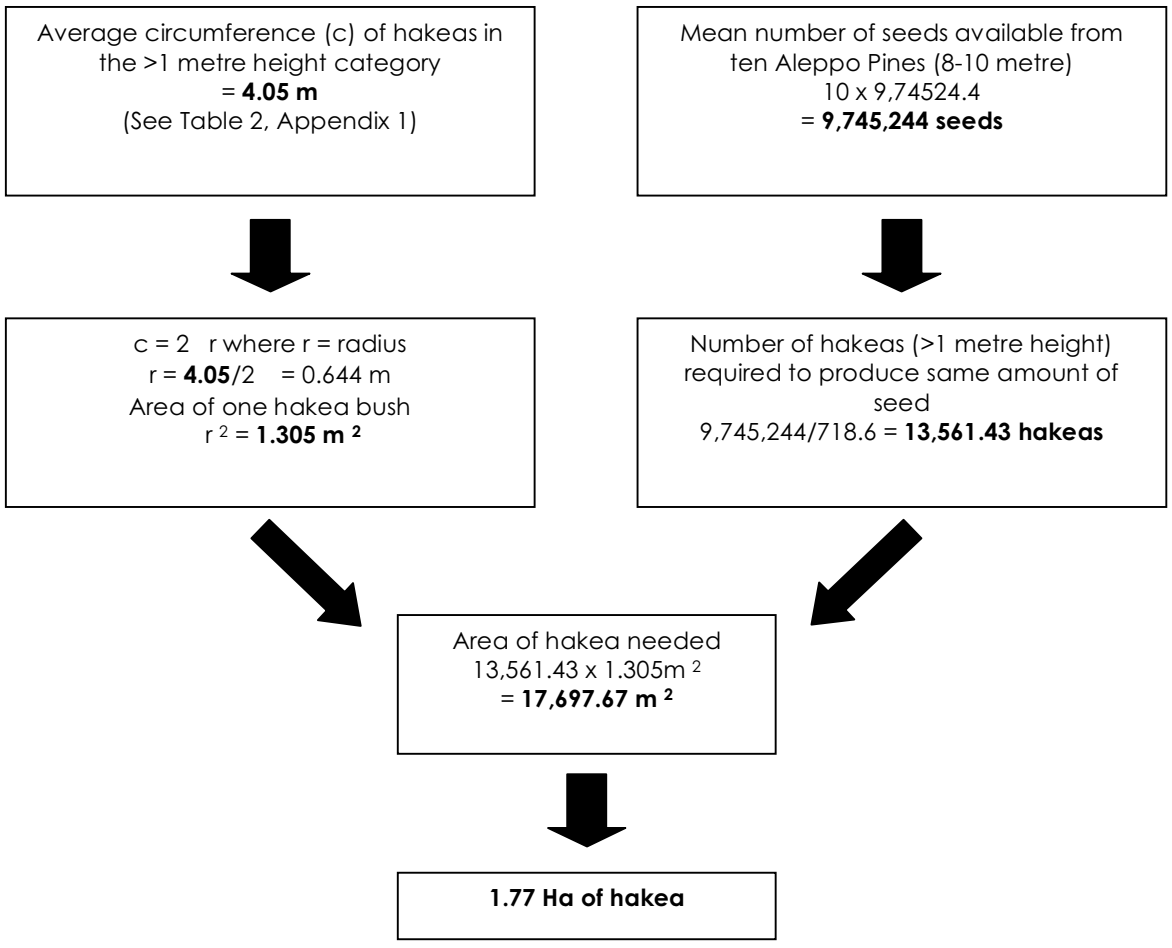
A row of 10 Aleppo Pines (all of 8–10 metres in height) is removed from within the EPYTBC breeding area.

Question

How many hectares (10,000 m^2) of revegetation are needed to provide the equivalent food resource of these pines?

Assumptions

- Revegetation is with Wrinkled Hakea only (the most productive of the EP Hakea species.)
- The (two dimensional) area of a hakea bush is estimated by equating it to a circle (r^2).



Revegetation with predominately Hakea species is the preferred recovery action in some key foraging areas within the EPYTBC breeding habitat and is an important component of EPYTBC conservation. However, general revegetation should ideally include a mixture of locally indigenous plant species.

As an estimate, a naturally occurring hectare of Sugar Gum Woodland in good condition may contain about 5% (500 m^2) hakea species (S Bey [Greening Australia], pers. comm.). Based on the required equivalent number of hakea being 13,561.43, if the revegetation tries to mimic an approximated natural abundance of 5% per hectare, the area needing to be revegetated in this manner is:

5% Ha = 500 m^2
Area of one hakea = 1.305 m^2
500/1.305 = 383.14 is number of hakeas represented at 5% abundance

Therefore, to provide the equivalent 13, 561.43 hakeas at 5% abundance
383.14/13,561.43
= 35.4 Ha of revegetation with 5% hakeas

5.2 Limitations for revegetation

Revegetation is a critical recovery action to help ensure the survival of EPYTBCs and other threatened species occurring in Sugar Gum Woodlands and Heathlands. However, revegetation *per se* may not provide adequate EPYTBC food resources on EP to replace that provided by Aleppo Pines. As well as the above example of the high ratio of available seed of Aleppo Pine to hakea, there are several other reasons for this:

- large-scale habitat loss. Since European settlement, lower EP has lost significant areas of native vegetation (Figure 2). Widespread land use changes throughout the EPYTBC breeding area (now primarily privately owned and agricultural) also limit the opportunity for revegetation. It simply may not be feasible to provide adequate native food resources to sustain EPYTBCs in the long term
- the habitual feeding behaviour of the birds and their reliance on known, historic feeding locations
- currently, there are no data to suggest that the EPYTBCs will decrease their utilisation of Aleppo Pines if revegetation of native food resources increases. Not enough is known to predict whether this will or will not be a significant behavioural response. However, based on their feeding behaviour (see above), the location of revegetated food resources will have a major influence on utilisation
- appropriate fire management to ensure regeneration of food plants such as Yacca and hakea species in the long term is not always practical considering the private agricultural environment where many remnants occur
- economic costs and limited resources.

Strategic revegetation will increase native food availability for the EPYTBC and provide more foraging habitat in the long term. However, revegetation needs to be planned closely with the rate of Aleppo Pine removal from key areas over time to allow for:

- feeding behaviour of the EPYTBC. The birds may take several seasons and/or generations to locate and learn the areas of new forage. For example, one area of hakea revegetation in the middle of the breeding area was 4 years old and had been producing cones for at least 2 years before monitoring identified EPYTBC feeding signs at the site
- certain native food plants (e.g. Yaccas and Hakeas) take several years to flower and provide suitable forage. Revegetation involves a significant time lag before plants begin to produce seeds and flowers.

6 ALEPPO PINE MANAGEMENT ON LOWER EYRE PENINSULA

6.1 Past and current control efforts

The rationale for Aleppo Pine control is widely recognised and well documented. Aleppo Pines were listed as a Proclaimed Pest species on southern Eyre Peninsula in 1992 (under the *Animal and Plant Control Act 1986*, now the *Natural Resources Management Act 2004*). This listing applies to *feral* populations only, that is, Aleppo Pines that are not planted. It is still legal to buy and plant Aleppo Pines on private land, however the landholder is responsible for controlling any feral seedlings that may emerge.

The Lower Eyre Pest Management Group (previously the Southern Eyre Aleppo Pine Management Group) formed in 1997 to control infestations of feral pines on public land. In the past, significant control efforts have occurred at:

- The Fountain, Flinders Highway
- Uley Wanilla Basin
- Yallunda Flat
- Coffin Bay approach road.

Depending on the site, control has often involved bulldozing, stockpiling for 12-18 months and burning. Seedling control and revegetating with locally indigenous species has occurred as key follow-up activities. Prison work teams, Australian Trust for Conservation Volunteers and local Green Corps groups have also targeted juvenile pines with handsaws and direct pulling of seedlings.

Aleppo Pine control has been carried out to protect biodiversity and help maintain road safety. Local government and community group involvement has also influenced the location and amount of effort that has gone into pine control.

6.2 Implications of the Wangary Fire, January 2005

6.2.1 Implications on Aleppo Pine abundance on lower Eyre Peninsula

On 12 January 2005, a bushfire originating near Wangary burned across 82,000 hectares of lower Eyre Peninsula (Figure 11). The fire destroyed numerous Aleppo Pines and many others have been felled since the fire.

Figure 11 The January 2005 Wangary fire scar across lower Eyre Peninsula

Despite many pines being destroyed, the fire has not eliminated Aleppo Pine infestations from lower Eyre Peninsula. Depending on fire behaviour, Aleppo Pines may respond to fire with mass germination of released seed from their cones (Daskalakou and Thanos 1996) and this process is expected in some areas across the fireground. This germination peaks with the first rains post-fire and diminishes in the seasons to follow, as soil seed banks are short-lived.

To inform post-fire management of Aleppo Pines, a quantitative estimate of remaining mature trees has been made.

6.2.2 Impact on Aleppo Pine EPYTBC food resources

More than half of the Aleppo Pines throughout the EPYTBC breeding area were destroyed during the Wangary fire (Table 7). Pines lost include at least two critical feeding sites in the breeding area and the majority of stands at Wanilla Forest, another important feeding area. Considering this loss, it is possible that stands not previously regarded as important EPYTBC food trees before the fire may now become important to the birds' survival on Eyre Peninsula.

Mass Yacca flowering stimulated by the fire supplied important food resources in the form of *Meyriccia latro* insect larvae. In light of the widespread loss of food resources, including Aleppo Pines, this short-term abundance of food was heavily utilised by the birds during the 2005-2006 breeding season. However the abundance of Yacca flowering is expected to normalise in subsequent seasons and, consequently, so too the availability of *Meyriccia latro* larvae. The loss of food resources, particularly Aleppo Pines, in the EPYTBC breeding area is expected to have a long-term impact on EPYTBC recovery.

Table 7 Loss of Aleppo Pines in EPYTBC habitat

	Aleppo Pines lost	**Aleppo Pines remaining**
Fireground	1,706.5 (64%)	958.5 (35%)
EPYTBC breeding area and/or known feed sites	275.5 (69%)	119.5 (30%)

7 ALEPPO PINE SURVEY, 2005

7.1 Methods

7.1.1 Field survey

In March 2005, Aleppo Pines were re-surveyed by the Department for Environment and Heritage along roadsides and, where possible, on private land. The Wangary fire ground and unburnt ground south of Bratten Way, from Mount Hope in the west to Tumby Bay in the east, was surveyed. Kellidie Bay Conservation Park, Coffin Bay and Lincoln National Parks, Wanilla Forest, SA Water land and the majority of the Flinders Highway were not re-surveyed.

Extensive Aleppo Pine infestations occur throughout remnant vegetation on SA Water land (Uley Wanilla, Uley South and Lincoln Basins). SA Water is working to an Aleppo Pine management plan as outlined in Quarmby (2004) and is therefore not dealt with in this report apart from identifying current EPYTBC feed trees for retention.

At each site the following data were collected during site inspections:

- position using a GPS (UTM, Zone 53H, datum WGS84)
- digital photo where possible
- number of pines. Where pines were unable to be accurately counted, numbers were estimated or the approximate extent of the infestation was given in metres
- percentage burnt
- tenure (private or public land/roadside)
- Eyre Peninsula Yellow-tailed Black-Cockatoo (EPYTBC) feeding signs or knowledge of past feeding records.

7.1.2 Identifying and assessing impacts to biodiversity values

To prioritise Aleppo Pine sites for eradication or retention and management, each site was assessed for its impact or potential impact on biodiversity values. The major impact of Aleppo Pines on biodiversity is the species' ability to form extensive infestations, out competing native vegetation and impeding germination of indigenous species. Therefore, impact was largely interpreted as risk of infestation into areas of biodiversity value. This was assessed using a variety of biodiversity data including existing databases and mapping. Aleppo Pine sites were considered to have a greater negative impact on biodiversity values if they were adjacent to, or in the vicinity of:

- remnant vegetation including Heritage Agreements and unprotected native vegetation remnants (resources utilised: DEH Biomaps and Ancell, 2004)
- national parks, conservation parks and conservation reserves (resources utilised: DEH Biomaps)
- significant roadside vegetation (resources utilised: DEH roadside mapping, Lower EP)
- threatened flora sites and threatened ecosystem remnants (resources utilised: DEH Biomaps, Ancell, 2004 and K Pobke [Department for Environment and Heritage], pers. comm.).

Department for Environment and Heritage EPYTBC database records (e.g. Aleppo Pine feeding sites, breeding and general observations) were overlayed with Aleppo Pine data to identify overlap of critical habitat and important Aleppo Pine feeding sites.

7.1.3 Setting control priorities

Each site received a recommended control priority. *Control* in this case refers to the local eradication of Aleppo Pines at a particular site.

The control priority designated was dependent on the desktop analysis and associated negative or positive impacts on biodiversity for that particular site. Priorities are defined as:

- Control – High
- Control – Medium or Low
- Retain (and manage emergent seedlings where appropriate)
- Retain (P) where the P identifies sites on private land.

7.2 Results

7.2.1 Field survey

Raw data is shown in Appendix 3 and photo records of pine sites accompany this report on CD.

A total of 253 sites were surveyed. Just over half of the mapped Aleppo Pine sites occur on private land (127 of 253 sites). '*P'* in the table in Appendix 3 identifies private land sites.

Visual representation of Aleppo Pine site data is shown in Map 2 as number of trees per site and Map 3 as percentage of burnt trees per site.

Every effort was made to document all pine sites, however some pines may have been overlooked, especially on private land. If land managers identify an Aleppo Pine site that has not been mapped for this report, the criteria and guidelines outlined in Section 8 can still be applied. Some Aleppo Pines on private land may have been removed since being surveyed.

7.2.2 Desktop analysis

Site impacts to biodiversity and control priorities are noted in Appendix 3. The number of sites designated in each priority category is shown in Table 8.

Table 8 Number of sites in control priority categories

Control priority	Number of sites
Control - High	56
Control - Medium	18
Control - Low	72
Retain (& manage if applicable)	43
Retain (P)	64
TOTAL	**253**

Map 4 displays a control boundary with three priority areas identified as priorities for Aleppo control (Sleaford Mere, Kellidie Bay and Coulta) as well as each site's control priority.

Map 1 shows EPYTBC distribution across lower EP, overlaying EPYTBC breeding and Aleppo Pine feeding records with Aleppo Pine sites (showing the number of trees per site). Eyre Peninsula Yellow-tailed Black-Cockatoo distribution across the whole of the Eyre Peninsula is shown in Figure 3.

7.3 Discussion

7.3.1 Protecting large remnant areas

Most large areas of intact remnant vegetation on lower EP occur to the west and south of Flinders Highway. These include at least 12 large Heritage Agreements (including Marble Range and South Block to the east), Lincoln Conservation Reserve, Sleaford Mere, Kathai, Kellidie Bay and Mount Dutton Bay Conservation Parks, and Coffin Bay and Lincoln National Parks.

The Aleppo Pines in these areas are already directly impacting biodiversity values or have the potential to invade high quality threatened vegetation communities. It is recommended that Aleppo Pines be controlled (locally eradicated) at Coulta, Kellidie Bay and Sleaford to the west of the highway (Map 4).

7.3.2 Private land

Control activities tend to focus on public land (e.g. parks, reserves and roadsides) rather than private property. Whilst pines on private land sites are usually in the middle of cropped or grazed areas and therefore pose a low risk of infestation, some Aleppo Pine shelterbelts are parallel to road reserves containing high quality native vegetation or threatened flora sites. These sites should also be considered as areas for high priority local eradication. Management of these sites may be achieved through cooperation between landholders and the relevant agencies.

8 A STRATEGIC APPROACH

8.1 Criteria for Aleppo Pine control

Aleppo Pine sites are identified for local eradication if:

1. **The site poses a high infestation risk to native vegetation such as high quality roadside remnants, threatened vegetation communities, threatened flora sites, Heritage Agreements, national parks and reserves,** *and*
2. **The site is more than 5 kilometres from the EPYTBC breeding area,** *and*
3. **There are no records of EPYTBC feeding at the site within the last 10 years,** *or*
4. **The site was 100% burnt during the January 2005 bushfire.**

Depending on site characteristics, the control priority *high*, *medium* or *low* was assigned (see Map 4 and Appendix 3). Site characteristic notes rationalise the assignment of high, medium or low prioritisation and are shown in Appendix 3.

In the case of criterion number two, shading in Map 4 identifies the 5 kilometre buffer around the currently known EPYTBC breeding area. The EPYTBC breeding area has been identified through the analysis and mapping of long-term data collected during nest monitoring as part of the jointly funded Department for Environment and Heritage and Eyre Peninsula Natural Resources Management Board EPYTBC Recovery Project. More information on EPYTBC breeding habitat is provided in van Weenen and Cooper (2000).

8.2 Criteria for Aleppo Pine retention and management

Pine sites are recommended for retention and management if:

1. **The site occurs in or within 5 kilometres of the EPYTBC breeding area,** *or*
2. **EPYTBC have been recorded feeding at the site within the last 10 years AND the site poses a minimum infestation risk to native vegetation such as high quality roadside remnants, threatened vegetation communities, threatened flora sites, Heritage Agreements, national parks and reserves,** *or*
3. **The site is on private land and poses a minimum infestation risk to biodiversity values.**

In the case of criterion number two, there are a minimal number of sites (less than 10%) where Aleppo Pines are recommended for retention and the site poses a risk to other biodiversity values. The majority of these occur on SA Water land (Uley Basin) and are recommended for priority management (i.e. removal of emergent seedlings) in agreement with SA Water.

In the case of criterion number three, infestation risk to biodiversity values is considered to be minimal where a site occurs in the middle of a cropped or grazed paddock (e.g. shelter belt or isolated paddock trees) at least 100 metres from remnant vegetation or roadside reserves containing native vegetation. Aleppo Pine seeds are wind dispersed and can carry for considerable distances on prevailing winds, however the majority of seeds fall to within 40-50 metres of the parent tree (Bulman 1992).

8.3 Guidelines for stakeholders

GUIDELINE 1

Locally eradicate pines at sites west of the designated boundary (excluding EPYTBC feed trees at SA Water Uley Basin and Duckponds), especially at:

1. Coulta

2. Kellidie Bay

3. Sleaford

as a first priority to protect high biodiversity values, large remnant areas and Reserves (Refer to Map 4).

GUIDELINE 2

When revegetating Aleppo Pine control sites, use locally indigenous species endemic to that area. If removing Aleppo Pines from areas with EPYTBC feeding records (more than 10 years old), ensure that revegetation occurs with a significant proportion of EPYTBC native food species such as:

- Wrinkled Hakea (*Hakea rugosa*)

- Elm-seed Hakea (*H. cycloptera*)

- Sugar Gum (*Eucalyptus cladocalyx*)

- Drooping Sheoak (*Allocasuarina verticillata*)

- Yacca (*Xanthorrhoea semiplana*),

in areas where these species are locally indigenous.

GUIDELINE 3

Where possible, commence pine eradication at sites located as far as possible from the EPYTBC breeding area and feeding sites.

(Refer to EPYTBC breeding area and buffer as shaded in Map 4).

Working towards the EPYTBC breeding area buffer, rather than away from it, compensates for the uncertainty in predicting the rate of EPYTBC recovery, the potential expansion of the cockatoos' foraging range and the utilisation of new nesting areas in response to the 2005 bushfire.

GUIDELINE 4

Retain and manage all unburnt Aleppo Pines within the EPYTBC breeding area and within 5 kilometres of the EPYTBC breeding area.

(Refer to EPYTBC breeding area and buffer as shaded in Map 4).

For more information about Aleppo Pines as a food resource for EPYTBCs, refer to van Weenen and Cooper (2000). Seedling control at retained Aleppo Pine sites for EPYTBCs is supported by the Department for Environment and Heritage, Green Corps, Lower Eyre Pest Management Group, Eyre Peninsula Natural Resources Management Board and community groups.

9 KEY RESOURCES, DOCUMENTS AND CONTACTS

9.1 Key documents

This report aims to complement several other relevant documents regarding general Aleppo Pine management, as well as specific management plans and mapping. These are listed below:

- Ancell, D 2004, *General principles and priorities for biodiversity conservation in the Eyre Peninsula NRM region*, Eyre Peninsula Natural Resource Management Group, Port Lincoln.
- Bulman, P 1992, *Aleppo Pines: Information Pamphlet 35/92*, Woods and Forests, South Australia.
- van Weenen, J & Cooper, J 2000, *Progress Report for the critically endangered population of the Yellow-tailed Black-Cockatoos (Calyptorhynchus funereus) on Eyre Peninsula, South Australia*.
- EAC 2004, *Vegetation Management Plan for Wanilla Forest*, a report prepared by EAC – Ecological Evaluation for Port Lincoln Aboriginal Community Council and Threatened Species Network SA.
- LEPMG 2003, Lower Eyre Pest Management Group Constitution.
- Quarmby, JP 2004, *Aleppo Pine Survey of Uley Wanilla, Uley South and Lincoln Basins: Report on the distribution and abundance of Aleppo Pine and recommendations for control*, SA Water Corporation.
- Southern Eyre Aleppo Pine Management Group 1997, *Aleppo Pine Management Plan*, Southern Eyre Aleppo Pine Management Group, now the Lower Eyre Pest Management Groups (LEPMG).
- Lower Eyre Pest Management Group website: www.pestandweed.com
- Map series of Aleppo Pine roadside infestations on Lower Eyre Peninsula. Available from the Eyre Peninsula Natural Resources Management Board (EPNRM) (formerly the Southern Eyre Animal and Plant Control Board). (These data are also represented in the EPNRM's Biodiversity Audit map series (EPNRM, 2005).

9.2 Key contacts

The following people can be contacted for further information:

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- members of the Lower Eyre Pest Management Group
- Michael Wakeman, Peter Samuel and Monique Blason, SA Water
- Heather Michael, Aboriginal Lands Trust and Port Lincoln Aboriginal Community Council
- Michael Newchurch, Port Lincoln Aboriginal Community Council
- landholders of the Koppio Hills region.

11 REFERENCES

Ancell, D 2004, *General principles and priorities for biodiversity conservation in the Eyre Peninsula NRM region*, Eyre Peninsula Natural Resource Management Group, Port Lincoln.

Bulman, P 1992, *Aleppo Pines: Information Pamphlet 35/92*, Woods and Forests, South Australia.

Cooper, CE, Withers, PC, Mawson, PR, Bradshaw, SD, Prince, J & Robertson, H 2002, 'Metabolic ecology of cockatoos in the south-west of Western Australia', *Australian Journal of Zoology*, vol. 50, pp. 67-76.

Csurches, S & Edwards, R 1998, *Potential environmental weeds in Australia*: *candidate species for preventative control*, Queensland Department of Natural Resources, Coorparoo, Queensland.

Daskalakou, EJ & Thanos, CA 1996, 'Aleppo Pine (*Pinus halepensis*) post-fire regeneration: The role of canopy and soil seed banks', *International Journal of Wildland Fire*, vol. 6, no. 2, pp. 59-66.

Environment Australia 1998, *Recovery Plan for the Mt Lofty Ranges Southern Emu-wren (*Stipiturus malachurus intermedius*) 1999-2003*, produced by the Mt Lofty Ranges Southern Emu-wren Recovery Team for Environment Australia.

Freebairn, A 2003, *Draft Recovery Plan for 25 plant taxa on Eyre Peninsula, South Australia 2004-09*, unpublished draft, South Australian Department for Environment and Heritage.

Quarmby, JP 2004, *Aleppo Pine survey of Uley Wanilla, Uley South and Lincoln Basins: report on the distribution and abundance of Aleppo Pine and recommendations for control*, SA Water Corporation.

Richardson, D 2003, 'Habitat preference of southern brown bandicoots in Belair National Park', *SA Naturalist*, vol. 77, no 1/2, pp. 37-38.

Richardson, DM, Cowling, RM & Le Maitre, DC 1990, 'Assessing the risk of invasive success in *Pinus* and *Banksia* in South African mountain fynbos' *Journal of Vegetation Science*, vol. 1, pp. 629-642.

Richardson, DM, Williams, PA & Hobbs, RJ 1994, 'Pine invasions in the southern hemisphere: determinants of spread and invadability' *Journal of Biogeography*, vol. 21, pp. 511-527.

Robertson, M 1994, *Stop bushland weeds: a guide to successful weeding in south Australia's bushland*, The Nature Conservation Society or South Australia Inc.

van Weenen, J & Cooper, J 2000, *Progress report for the critically endangered population of Yellow-tailed Black-Cockatoos (Calyptorhynchus funereus) on Eyre Peninsula, South Australia*, unpublished report for the Department for Environment and Heritage, South Australia.

Virtue, JG & Melland, RL 1999, *The environmental weed risk of revegetation and forestry plants*, Animal and Plant Control Commission, Department of Water, Land and Biodiversity Conservation and Cooperative Research Centre for Australian Weed Management, South Australia.

Way, S 2004, *The Eyre Peninsula Yellow-tailed Black-Cockatoo (*Calyptorhynchus funereus xanthanotus*) and the introduced Aleppo Pine (*Pinus halepensis*) on Eyre Peninsula, South Australia*, unpublished report for the Department for Environment and Heritage, South Australia.

APPENDIX 1: NUTRITIONAL ANALYSIS DATA

Analysis conducted by the Nutritional Research Laboratory of the Pig and Poultry Production Institute, South Australian Research and Development Institute.

Lab. no.	Sample ID	Dry matter (%)	Crude Protein (% of dry matter)	ADF (% of dry matter)	ME (MJ/kg DM)
A50257	Aleppo Pine (*Pinus halepensis*)	93.8	24.80	58.7	12.6
A50258	Wrinkled Hakea (*Hakea rugosa*)	90.8	64.60	27.2	12.6
A50259	Elm-seed Hakea (*H. cycloptera*)	91.6	47.90	37.6	13.5

Lab. no.	Sample ID	Gross Energy (MJ/kg)	Crude Fat (%)	Ash (%)	Total Starch (%)
A50257	Aleppo Pine (*Pinus halepensis*)	**25.74**	**34.08**	**7.73**	**1.3**
A50257	DM, as received	**24.29**	**32.15**	**7.29**	**1.23**
A50258	Wrinkled Hakea (*Hakea rugosa*)	19.07	12.27	7.88	1.1
A50259	Elm-seed Hakea (*H. cycloptera*)	21.12	19.89	6.51	0.38

Nutritional analysis data continued

Amino acids (g/100g)	**Aleppo Pine**	**Aleppo Pine** **(DM, as received)**	**Wrinkled Hakea**	**Elm-seed Hakea**
	A50257	**A50257**	**A50258**	**A50259**
Aspartic acid	**3.00**	**2.83**	4.48	3.35
Threonine	**0.96**	**0.91**	0.43	0.45
Serine	**1.79**	**1.69**	0.99	0.89
Glutamic acid	**9.92**	**9.36**	8.30	6.54
Glycine	**1.35**	**1.27**	1.84	1.44
Alanine	**1.41**	**1.33**	0.99	0.91
Valine	**1.50**	**1.42**	0.86	0.86
Methionine	**0.62**	**0.59**	0.24	0.32
Isoleucine	**1.01**	**0.95**	0.96	0.81
Leucine	**2.26**	**2.14**	1.98	1.84
Tyrosine	**0.90**	**0.85**	1.06	0.85
Phenylalanine	**1.17**	**1.10**	0.72	0.74
Lysine	**0.64**	**0.61**	0.52	0.46
Histidine	**0.72**	**0.68**	0.72	0.46
Arginine	**6.63**	**6.26**	8.72	6.44
Proline	**1.71**	**1.61**	0.70	0.82

Nutritional analysis data continued

Mineral results – reported on an OVEN DRIED basis by Waite Analytical Services

	Fe (mg/kg)	**Mn (mg/kg)**	**B (mg/kg)**	**Cu (mg/kg)**	**Mo (mg/kg)**	**Co (mg/kg)**	**Ni (mg/kg)**
Aleppo Pine (*Pinus halepensis*)	210	32	12	15	0.93	< 0.4	< 0.8
Wrinkled Hakea (*Hakea rugosa*)	330	490	17	43	< 0.8	< 0.4	4.6
Elm-seed Hakea (*H. cycloptera*)	81	165	16	43	0.97	< 0.4	2.8

	Zn (mg/kg)	**Ca (mg/kg)**	**Mg (mg/kg)**	**Na (mg/kg)**	**K (mg/kg)**	**P (mg/kg)**	**S (mg/kg)**
Aleppo Pine (*Pinus halepensis*)	81	1560	3600	420	5000	7800	2600
Wrinkled Hakea (*Hakea rugosa*)	181	15500	5900	450	8300	16900	6200
Elm-seed Hakea (*H. cycloptera*)	153	6100	7300	580	8600	16500	6000

	Al (mg/kg)	**Ti (mg/kg)**	**Cr (mg/kg)**	**Cd (mg/kg)**	**Pb (mg/kg)**	**Se (mg/kg)**
Aleppo Pine (*Pinus halepensis*)	4.4	< 0.1	2.5	< 0.2	<2	< 7
Wrinkled Hakea (*Hakea rugosa*)	90	0.63	2.4	< 0.2	<2	< 7
Elm-seed Hakea (*H. cycloptera*)	15	< 0.1	0.98	< 0.2	<2	< 7

APPENDIX 2: RAW DATA – TOTAL CONES AND SEEDS PER PLANT

Lower Eyre Peninsula, September 2005

GPS Datum is WGS84

Table A2.1 Aleppo Pine raw data

SITE	EASTING	NORTHING	HEIGHT CATEGORY (m)	DBH (m)	NUMBER OF CONES	BRANCH LENGTH (m)	NUMBER OF BRANCHES	2/3 OF NUMBER OF BRANCHES
ULEY	560236	6163970	6-8	0.73	47	2.5	52	34.67
THE PINES	570793	6161853	6-8	0.34	5	2.1	39	26.00
PL GOLF COURSE	573983	6161036	6-8	0.98	177	4.7	61	40.67
ULEY	560236	6163970	8-10	1.26	170	4.2	64	42.67
THE PINES	570793	6161853	8-10	1.16	29	2.3	93	62.00
PL GOLF COURSE	573983	6161036	8-10	0.91	100	4.4	51	34.00
ULEY	560236	6163970	10-12	1.24 + 1.42	111	3.8	100	66.67
THE PINES	570793	6161853	10-12	1.05	105	3.6	51	34.00
PL GOLF COURSE	573983	6161036	10-12	2.48	164	5	90	60.00

Table A2.1 continued

SITE	HEIGHT CATEGORY (m)	CONES/tree	SEEDS/tree	MEAN CONES/tree	SE CONES/tree	MEAN SEEDS/tree	SE SEEDS/tree
ULEY	6-8	1629.33	382567.47	2985.78	2150.12	701060.62	504849.34
THE PINES	6-8	130.00	30524.00				
PL GOLF COURSE	6-8	7198.00	1690090.40				
ULEY	8-10	7253.33	1703082.67	4150.44	1618.90	974524.36	380118.42
THE PINES	8-10	1798.00	422170.40				
PL GOLF COURSE	8-10	3400.00	798320.00				
ULEY	10-12	7400.00	1737520.00	6936.67	1824.76	1628729.33	428453.35
THE PINES	10-12	3570.00	838236.00				
PL GOLF COURSE	10-12	9840.00	2310432.00				

DBH = diameter at breast height, m = metres, SE = Standard error

Table A2.2 Wrinkled Hakea raw data

Site	Height (m)	Circumference (m)	Basal stem diameter (m)	No. Cones	Mean no. Cones	Standard Error
Revegetation, Charlton Gully Road						
53H 571081, 6177509	0.650	2.630	0.110	69	115.33	26.28
	0.760	3.100	<0.10	117		
	0.560	3.500	<0.10	160		
Roadside Vegetation, Flinders Highway						
53H 567687, 6163940	1.200	4.500	0.190	287	359.33	95.72
	1.330	4.100	0.180	549		
	1.260	3.550	0.175	242		

m = metres

APPENDIX 3: ALEPPO PINE SITES – RAW DATA

KEY

* - GPS datum in WGS84, UTM, Zone 53H

CP – Conservation Park

CR – Conservation Reserve

HA – Heritage Agreement

Y – Yes

R – significant roadside vegetation

REF – Reference number

TF – Threatened flora

TVC – Threatened vegetation community

REF	PRIORITY	PHOTO ID	DATE	No. PINES	% BURNT	% UNBUNRT	EPYTBC Feeding	Other biodiversity significance	Easting*	Northing	LOCATION	NOTES
1	2 C-L	107	21/02/2005	9	91	9			570237	6170630	McFarlane Rd / Rd side	
2	3 R-P	106	21/02/2005	6	90	10			570478	6170767	McFarlane Rd	
3	3 R-P	n/a	21/02/2005	100	95	5			571977	6170681	McFarlane Rd	
4	3 R	104	21/02/2005	5	0	100			574086	6172010	McFarlane Rd	unburnt on periphery of EPYTBC br. Area
5	3 R-P	103	21/02/2005	10	50	50			574993	6169734	Chapman Rd	low risk, in middle of paddock
6	3 R-P	102	21/02/2005		100	0			575184	6169068	Chapman Rd 500m extent	low risk, approx 500m hedgerow in paddock
7	2 C-L	102	21/02/2005		30	70			575630	6167442	Chapman Rd / Rd side	approx 1.2km extent
9	3 R -P	101	21/02/2005	5	100	0			575628	6167794	Chapman Rd / gully in paddock	gully in paddock
10	2 C-LB	100	21/02/2005	4	100	0			561793	6171183	Borlase Rd?	along driveway
12	3 R -P	97	21/02/2005	6	0	100			562458	6173824		in paddock
13	1 C-HP	96	21/02/2005	1	0	100		HA TVC	556798	6176894	Wylie Rd	adj. To HA & thr. veg comm. (*Melaleuca halmaturorum* tall shrubland)
15	1 C-HP	93	21/02/2005	1	100	0		HA CP TVC TF	555194	6178012	Settlers Rd	adj. To Murrunatta CP thr. veg comm. (*Melaleuca halmaturorum* tall shrubland) & thr flora site (Ironstone Mulla Mulla). Close to HA.
16	1 C-HP	92	21/02/2005	2	50	50		TF	549156	6181954	Yorks Gully Rd	near Thr flora site. Details not available.
17	3 R-P	91	21/02/2005		99	1			554901	6181332	Yorks Gully Rd	2 rows, 100m extent each in paddock
18	3 R-P	n/a	21/02/2005	4	0	100			557069	6181223	Exchange Rd	
19	2 C-MB	90	21/02/2005	5	100	0		TF	558928	6180367	Exchange Rd	near thr. veg comm.(*Eucalyptus camaldulensis* woodland)
20	2 C-L	89	21/02/2005	15	0	100			560142	6184760	Warunda Rd	
22	3 R-P	w of Warunda rd	22/02/2005		0	100			553605	6185776	West of Western end of Warunda Rd	
23	3 R-P	84	22/02/2005	4	0	100			552722	6185249	Warunda Rd	
24	3 R	83	22/02/2005	100	80	20	Y	TVC	575489	6176137		EPYTBC breeding area. Near Thr veg. comm. (*E. Cladocalyx* woodland).
25	2 C-LB	82	22/02/2005	5	100	0			576072	6172558	Murray Rd	
26	3 R-P	81	22/02/2005	10	90	10			578964	6170289	Murray Rd in paddock	low risk in paddock
28	1 C-H	79	28/02/2005	4	0	100	Y	TF TVC	583014	6192996	Pillaworta Rd	EPYTBC historical feeding but near thr flora (Silvery Spyridium & Leafless Glob-pea) & thr veg comm (*E. cladocalyx* woodland*)* Many burnt & already removed
29	2 C-M	78	28/02/2005	200+	90	10	Y	TVC TF	579796	6189813	Pillaworta Rd/ Koppio Rd roadside	EPYTBC historical feeding but near thr flora (Tufted Bush-pea) & thr veg.comm.(*E. cladocalyx* woodland)
30	3 R-P	77	28/02/2005	50	0	100		HA TF	578326	6190630	Koppio Rd	Seedling control, nearby Heritage Agreements & thr flora (Feathery Wattle, Tufted Bush-pea) to the north east but stand off roadside & in paddock.
31	3 R	76	28/02/2005	30	0	100	Y	TVC	577865	6190780	Koppio Museum area	Seedling control along roadside, past EPYTBC feeding site. Near Thr veg. comm. (*E. cladocalyx* woodland).
32	3 R-P	75	28/02/2005	60	10	90			578197	6192110	Yallunda flat Rd	Shelter belt in middle of paddock
33	2 R	74	28/02/2005	30	0	100	Y	TVC	577661	6192092	Koppio Cemetery	EPYTBC feeding, 2006. Near Thr veg. comm. (*Casuarina pauper Low Woodland)*).
34	3 R-P	73	28/02/2005	5	0	100			577530	6191606	Yallunda flat Rd	Private land, in paddock near buildings. Some near roadside burnt + removed

REF	PRIORITY	PHOTO ID	DATE	No. PINES	% BURNT	% UNBUNRT	EPYTBC Feeding	Other biodiversity significance	Easting*	Northing	LOCATION	NOTES
35	2 C-LB	n/a	28/02/2005		100	0	Y		575108	6188468	Dennis Rd	no photo. 400m extent. Danger of post-fire seedling germinations?
36	2 C-LB	73a	28/02/2005	20	100	0		TVC	578447	6182725	White flat Rd just STH of Todd Res	Danger of post-fire seedling germinations? EPYTBC feeding site within 2kms.Some already removed. Near Thr veg. comm. (*E. cladocalyx* woodland).
37	2 C-LB	71	28/02/2005	30	99	1			578517	6181629	White Flat Rd	Danger of post-fire seedling germinations?
38	2 C-LB	70	28/02/2005	2	100	0		TVC	578661	6180151	White Flat Rd	Danger of post-fire seedling germinations? Near thr. Veg comm (*Allocasuarina verticillata* grassy low woodland) sites
39	2 C-LB	69	28/02/2005	30	100	0			578254	6180722	White Flat Rd	Danger of post-fire seedling germinations?
40	3 R	68	28/02/2005	10	60	40	Y		576037	6176201	Gawler ponds	EPYTBC breeding area
41	3 R-P	67	28/02/2005	30	50	50			576812	6171287	Murray Rd	
42	2 C-LB	66	28/02/2005	100	100	0			576557	6170380	Murray Rd	
43	3 R-P	Green Ln	28/02/2005	6	50	50		TF	577680	6173158	Green Lane	Shelter belt in paddock, so low risk to nearby threatened flora site(Feathery Wattle)
44	3 R-P	WFR1	28/02/2005	2	0	100			578577	6179718	White flat Rd	Two in farmyard where house was lost, may have been removed since fire? Low risk
45	2 C-L	WFR2	28/02/2005	30	90	10			579055	6178353	White flat Rd	Not close to threatened flora, roadside mapped as limited native veg in poor condition. Private land or along road reserve?
46	3 R-P	n/a	28/02/2005	20	80	20			580296	6175997	White flat Rd	In farm yard, low risk & not close to thr. Flora sites
47	3 R-P	LincolnHwy4	28/02/2005	6	0	100			583578	6177077	Lincoln Hyw	Low risk, private land
48	2 C-L	Lincoln Hyw	28/02/2005	100	90	10			583275	6176563	Lincoln Hyw Road side	Shelter belt on private land. Potential to spread along highway road reserve, although no threatened flora sites nearby
49	3 R-P	Lincoln hyw 2	28/02/2005	50	90	10			581472	6174094	Lincoln Hyw Road side	Most are burnt, private land
50	2 C-L	Poonindie church	28/02/2005	25	20	80			580621	6172749	Poonindie church Lincoln Hyw	
51	2 C-L	Airport	28/02/2005	50	0	100		TF	579955	6170582	Lincoln Airport	Roadside shelter belt. Perhaps infestation risk to threatened flora (Lehmann's Apple-berry, trailing Nancy & Erect Sundew) & native veg to the east at Point Boston
52	3 R	Hyde Rd	28/02/2005	20	80	20			578656	6167174	Hyde Rd Lincoln Hyw	Roadside has been mapped as very little or no native veg. present
53	3 R-P	Hyde Rd2	28/02/2005	50	0	100			576469	6166999	Hyde Rd	Private land, driveway shelterbelt. Roadside has been mapped as very little or no native veg. Present
54	3 R-P	Clarke Lane 1	28/02/2005	10	90	10			575334	6170103	Clarke lane	Low risk, in paddock.
55	2 C-L	Clarke Lane2	28/02/2005	5	0	100			577340	6168489	Clarke lane	Private land, in gully in paddock
56	2 C-L	Clarke Lane 4	28/02/2005	30	99	1			577647	6168463	Clarke lane	Shelter belt on private land. Potential to spread along road reserve if post-fire germination (all burnt), although no native veg.
57	3 R-P	Clarke lane 3	28/02/2005	1	100	0			579060	6168802	Clarke lane	In paddock near house
58	3 R	n/a	1/03/2005	50	50	50	Y		579136	6167505	NTH Shields	EPYTBC past feeding records. Seedling control.
59	3 R	LincolnHwy3	1/03/2005	100	70	30			578953	6167310	Lincoln Hyw	Location is not threatened native veg remnants or threatened flora.
60	3 R	Lions hostel	1/03/2005	11	50	50			579332	6168181	Lions Hostel Lincoln Hyw	Location is not threatened native veg remnants or threatened flora.
61	2 C-L	LincolnHwy5	1/03/2005	15	50	50			580294	6172224	Lincoln Hyw	Location is not threatened native veg remnants or threatened flora. Private land?
62	3 R-P	Talala	1/03/2005		60	40			583505	6179375	Lincoln Hyw 800m extent	800m extent. Shelter belt in cropped paddock, no native veg, low risk.
63	3 R-P	LincolnHwy6	1/03/2005	5	0	100			585274	6183587	Lincoln Hyw	Low risk, in middle of cleared paddocks
64	1 C-H	n/a	1/03/2005	10	50	50		TF TVC R	586902	6183085	Moonlight Bay Rd / Myalpa	No photo. Location is close to threatened flora sites (Large-fruit Crassula, Creeping Boobialla) and thr. veg comm. (*Melaleuca halmaturorum* tall shrubland & *M. uncinata* shrubland) & roadside is mapped as signif. Veg in moderate condition
65	2 C-M	LincolnHwy7	1/03/2005	20	0	100		TF TVC	586542	6184723	Lincoln Hyw	Control if possible, private land? Threatened flora sites (Large-fruit Crassula, Creeping Boobialla) and thr. veg comm. (*Melaleuca halmaturorum* tall shrubland & *M. uncinata* shrubland) to the SE
66	3 R-P	Bailer hill Rd	1/03/2005	10	10	90			586855	6185898	Bailer hill Rd	Low risk, isolated in paddock
67	2 C-L	WhiteRiver	1/03/2005	20	40	60			586110	6186834	White River	Low risk, but good to reduce risk of spread along roadside.
68	2 C-L	Bailer hill Rd 2	1/03/2005	2	50	50			585599	6186861	Bailer hill Rd	Two isolated, remove to stop roadside spread, easy to control

REF	PRIORITY	PHOTO ID	DATE	No. PINES	% BURNT	% UNBUNRT	EPYTBC Feeding	Other biodiversity significance	Easting*	Northing	LOCATION	NOTES
69	1 C-H	CrnBailerHillRockValley Rd	1/03/2005	100	50	50			582009	6188635	Corner Bailer hill Rd / Rock valley Rd	Young roadside infestation
70	2 C-L	Roadside	1/03/2005	3	50	50			581769	6188142	Roadside	Private property? Shelter belt parallel to road.
71	3 R-P	Rock ValleyRd	1/03/2005	10	90	10			581440	6188146	Rock Valley	Shelter belt in middle of paddock, some along roadside
72	1 C-H	Sheoak Rd	8/03/2005	2	n/a	n/a		NP, CR TF	572632	6149006	Sheoak Rd Tulka	Near thr flora sites (Port Lincoln Mallee, Spoon-leaf Spridium & Leafless Glob-pea. Close to Lincoln NP and Lincoln CR.
73	2 C-M	Grey Hound Rd	8/03/2005	17	n/a	n/a		TF	578473	6154375	Grey Hound Rd	Near two Thr Flora sites Port Lincoln Mallee & Allcock's Wattle & in native vegetation.
74	1 C-H	Tulka	8/03/2005	101	0	100		TF NP	571978	6148359	Tulka	Near thr flora sites (Port Lincoln Mallee, Spon-leaf Spridium & Leafless Glob-pea) & adjacent to Lincoln NP
75	1 C-H	Graphite1	8/03/2005		0	100		HA CR TH TVC	564700	6147778	Graphite Rd	Many small trees west side of road. Near HA, next to Lincoln CR & thr flora site (Snowdrop Spurge). Thr veg. comm. *Allocasuarina verticillata* Grassy Low Woodland.
76	1 C-H	Graphite2	8/03/2005	1	0	100		HA CR TF TVC	566556	6147825	Graphite Rd	near HA & Lincoln CR, Thr veg. Comm. (*Gahnia trifida* sedgeland & *Allocasuarina verticillata* Grassy Low Woodland)) & thr flora site (Snowdrop Spurge)
77	1 C-H	Sleaford mere	8/03/2005	10	0	100		CP R TVC	566166	6143243	Sleaford Mere	Post-fire EPYTBC obs but adjacent to significant rds veg in excellent condition. Adjacent to Thr Vegetation communities (*Gahnia trifida* sedgeland) & Sleaford Mere CP.
78	1 C-H	Sleaford Swamp	8/03/2005	40	0	100		CP R TVC	565938	6142545	Sleaford swamp	Adjacent to significant rds veg in excellent condition. Adjacent to Thr Vegetation communities (*Gahnia trifida* sedgeland and *Allocasuarina verticillata* Grassy Low Woodland) & Sleaford Mere CP.
79	1 C-H	Mere Cabins	8/03/2005		0	100		CP R TVC	565995	6142959	Nth end Mere cabins	Adjacent to significant rds veg in excellent condition. Adjacent to Thr Vegetation communities (*Gahnia trifida* sedgeland) & Sleaford Mere CP.. Many small-medium trees from swamp to this point
80	2 C-MP	Sleaford1	8/03/2005	10	0	100		R TVC TF CP, CR	564108	6144529	Fishery Bay Rd	Stand on private property but close to road reserve (Signif veg in moderate condition). Close to Lincoln CR & Sleaford Mere CP, Thr. veg comm.(*Allocasuarina verticillata* grassy low woodland.)& thr flora site (Leafless Glob-pea).
81	2 C-LP	Sleaford2	8/03/2005	4	0	100	Y	R TVC TF CP, CR	563884	6145208	Fishery Bay Rd	Past EPYTBC obs (last 2003) & FE record. Low infestation risk, part of windbreak in paddock. Close to road reserve (Signif veg in moderate condition). Close to Lincoln CR & Sleaford Mere CP, Thr. veg comm.(*Allocasuarina verticillata* grassy low woodland.)& thr flora site (Leafless Glob-pea).
82	2 C-LP	Sleaford3	8/03/2005	8	0	100		R TVC TF CP, CR	563715	6143835	Fishery Bay Rd	Stand in private driveway back from roadside (Signif veg in moderate condition on west). Close to Lincoln CR & Sleaford Mere CP, Thr. veg comm.(*Allocasuarina verticillata* grassy low woodland.)& thr flora site (Leafless Glob-pea).
83	1 C-HP	Sleaford4&5	8/03/2005	60	0	100		CP R	561275	6140225	Fishery Bay Rd	Wind break stand in paddock & stand along rds. ? Near Sleaford Mere CP.Adjacent to Thr. veg comm. (*Allocasuarina verticillata* grassy low woodland.).& near Thr Flora sites (Scaly Poa, Hidden Leek-orchid, EP Fringe-lily, Metallic Sun-orchid). Adj to signif roadside veg in moderate condition.
84	1 C-HP	n/a	8/03/2005	5	0	100		CP R	561781	6141394		Private land? Near Sleaford Mere CP. Thr. veg comm. (*Allocasuarina verticillata* grassy low woodland.)& near Thr Flora sites (Scaly Poa, Hidden Leek-orchid, EP Fringe-lily, Metallic Sun-orchid).Adj to signif roadside veg in moderate condition.
85	1 C-H	PineFreezerRd	8/03/2005	100	0	100			574750	6156388	Pony Club / Go kart Pine Freezer Rd	Young stand, control before infestation matures
86	1 C-H	144	8/03/2005	100	0	100		HA CP TVC	553794	6171707	Coffin Bay Rd	Adjacent to HA and Thr. veg comm.(Gahnia trifida sedgeland). Near Kellidie Bay CP
87	1 C-H	144	8/03/2005	100+	0	100		HA CP TVC	553311	6171636	Coffin Bay Rd	Adjacent to HA and Thr. veg comm.(Gahnia trifida sedgeland). Near Kellidie Bay CP
88	2 C-M	143&142	8/03/2005		0	100		TVC	544075	6176792	Dutton Bay Rd	Near Thr veg comm (*E. camaldulensis* woodland)
89	1 C-H	141	8/03/2005	60	0	100		TVC	540709	6179239		Adjacent to Thr Vegetation communities (*Allocasuarina verticillata* grassy low woodland, *Melaleuca hamauturorum* tall shrubland)

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90	1 C-H	140	8/03/2005	7	0	100		TVC	540436	6178487		Some already controlled. Adjacent to Thr Vegetation communities (*Allocasuarina verticillata* grassy low woodland, *Melaleuca hamauturorum* tall shrubland)
91	1 C-H	139	8/03/2005	20	0	100		TVC	539833	6178772	Mt Dutton	Adjacent to Thr Vegetation communities (*Allocasuarina verticillata* grassy low woodland, *Melaleuca hamauturorum* tall shrubland)
92	2 C-M	138	8/03/2005	20	0	100		TVC R	539727	6180158	Farm Beach Rd	Private or roadside? Near Thr Vegetation communities (*Allocasuarina verticillata* grassy low woodland and *Gahnia lanigera* sedgeland)
93	2 C-M	137	8/03/2005	15	0	100		TVC R	538955	6179257	Dutton bay west Dolphin Rd	Private or roadside? Adjacent to degraded significant rds veg & Near Thr Vegetation communities (*Allocasuarina verticillata* grassy low woodland and *Gahnia lanigera* sedgeland. Young infestation from adult trees still manageable.
94	2 C-M	136	8/03/2005	20	0	100		TVC	543643	6177876	Morgans Lane	near Thr. veg comm.(*E. camldulensis* woodland))
95	2 C-L	135	8/03/2005	100+	0	100	Y	TVC	543970	6177851	Between Wangary oval and store	EPYTBC FE record.Young stand, control before infestation matures.100 large trees & many seedlings already maturing. Near thr veg comm (*E. camldulensis* woodland)
96	2 C-M	n/a	18/03/2005	100+	0	100		TVC	544333	6178583	Edillilie Rd	Near thr veg comm (*E. camldulensis* woodland)
97	2 C-L	134	14/03/2005		0	100			565094	6192074	Edillilie 2 GPS points gives extent	Large infestation, may have historical values for townsfolk
98	3 R	134	14/03/2005	100+	0	100	Y	TF	564952	6191647	Edillilie	Historical value concerns. EPYTBC sightings since Wangary fire 2005. Close to Thr flora (Prickly Raspwort).
99	1 C-H	n/a	14/03/2005	20	0	100		TF	564921	6192361	Edillilie Todd Hwy	No photo. Close to threatened flora sites (Fat-leafed Wattle).
100	2 C-L	133	14/03/2005	200	0	100	Y	TF	565809	6195608	Todd Hwy	Close to thr. Flora site (Prickly Raspwort), but large shelter belt, Private land? & EPYTBC feeding site (2003/4)
101	3 R-P	132	14/03/2005	2	0	100		TF	565357	6195616	Todd Hwy	In farmyard, close to thr. Flora site (Prickly Raspwort)
102	2 C-L	131	14/03/2005		0	100		TF	565552	6198612	Todd Hwy	Nearby to Thr Flora site on Mickan Rd (Prickly Raspwort) but extensive (500m extent) roadside/private? Shelter belt
103	3 R-P	130	14/03/2005	50	0	100		TF	566783	6199568		Shelter belt in paddock, but in vicinity of thr flora site (Fat-leafed Wattle).
104	1 C-HP	129Tod	14/03/2005	100	0	100		TF	565781	6201047	Todd Hwy	Shelter belt along private driveway, but close to thr flora sites on Todd highway & Marble View Rd (Prickly Raspwort & Fat-leafed Wattle).
105	3 R-P	128	14/03/2005	200	0	100			567073	6201593		Shelter belts in paddock, private land.
106	1 C-HP	127Tod	14/03/2005	6	0	100		TF	565784	6203098	Todd Hwy	Shelter belts in paddock, but close to Thr flora site on Todd Highway (Prickly Raspwort).
107	1 C-HP	126Tod	14/03/2005	50	0	100		TF	565596	6204443		No photo. Private land, close to Thr flora site on Todd Highway (Prickly Raspwort)
108	1 C-HP	125Tod	14/03/2005	30	0	100		TF	564783	6204476	Todd Hwy	private land, shelter belt in paddock, close to Thr Flora sites (Prickly Raspwort)
109	1 C-HP	n/a	14/03/2005	1	0	100		TF	565232	6205634	Todd Hwy	private land, single tree near house.Close to Thr flora site (Prickly Raspwort)
110	1 C-HP	123Old	14/03/2005	20	0	100		TF	565877	6205931	old Caring	private land, shelter belt along driveway, close to 2xThr Flora sites (Prickly Raspwort)
111	1 C-HP	122	14/03/2005	80	0	100		TF	565828	6207012	Todd Hwy	private land, shelter belt along driveway (?), close to 2x Thr Flora sites (Prickly Raspwort)
112	1 C-HP	121 Cummins	14/03/2005	100	0	100		TF	566308	6207460	Cummins s	private land, shelter belt in paddock & driveway, close to 2xThr Flora sites (Prickly Raspwort)
113	1 C-HP	120 Warrow	14/03/2005	50	0	100		TF	561759	6208566	Warrow Rd	Private land, lining driveway 7 in paddock. Close to 3xThr Flora sites (Prickly Raspwort)
114	3 R-P	119	14/03/2005	60	0	100		TVC	559806	6203673		Private land, in house yard, close to thr. veg comm. (*E. odorata* & *leucoxylon*)
115	3 R-P	118	14/03/2005	25	0	100			556404	6199075	Settlers Rd	
116	1 C-H	117	14/03/2005	5	0	100		TVC	560624	6196335	Lawrie Rd	Private? Along driveway/roadside reserve & adjacent to Thr. veg comm. *Lamandra effusa* Tussock Grassland
117	1 C-HP	116	14/03/2005	20	0	100		HA TF TVC	561661	6192564		Private along driveway, adjacent to Heritage Agreement with Thr Flora sites (Tiny Arrow-grass, Grimlet Bog-rush, Large-fruit Crassula) and Thr veg comm (*Melaleuca uncinata* shrubland)
118	1 C-HP	115	14/03/2005	30	0	100		TF TVC	553788	6196625	Gap Rd	Private, shelter belt around farm house. Near 2x Thr. veg comm.(*Melaleuca uncinata* shrubland & *E. camaldulensis* woodland) and 2x Thr flora sites (*Levenhookia stipitata*, no common name)
119	2 C-L	114	14/03/2005	50	0	100			543154	6199546	Gap Rd	Low infestation risk, no native veg on rds, farmland adj.

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120	1 C-H	113Warrow	14/03/2005	5	0	100		TVC TF	541943	6199698	Warrow Rd	Near Thr Flora site (Salt Isotome), near Thr Vegetation community (*E. camaldulensis* woodland)
121	2 C-MP	11214_3	14/03/2005	20	0	100			543470	6197151		wind row in paddock
122	2 C-LP	109Coles	14/03/2005	1	0	100			538138	6195460	Coles Pt Rd	Low infestation risk, in paddock
123	2 C-M	108Frenchmans	15/03/2005	100+	0	100		TVC	539493	6187970	French mans Rd/Mewa Rd	Near EPYTBC feeding record, near Thr. veg comm.(*E. camaldulensis* woodland).Some already have been removed.
124	2 C-MP	107Poona	15/03/2005	50	0	100			542858	6197098	Poona lane	wind row in paddock
125	1 C-H	106Poona	15/03/2005	6	0	100		TVC	538056	6196970	Poona lane	Adj Thr. veg comm. (*E. camaldulensis* woodland)
126	2 C-LP	105Foster	15/03/2005	40	0	100		TVC TF	541635	6198207	Foster Rd	Wind row, low infestation risk. Near Thr. veg comm. (*E. camaldulensis* woodland, *Melaleuca halmaturorum* tall shrubland) & Thr flora site (Salt Isotome)
127	2 C-L	104	15/03/2005	6	0	100		TVC TF	541639	6198892	Foster Rd	Low infestation risk, no native veg on rds, farmland. Near Thr. veg comm. (*E. camaldulensis* woodland, *Melaleuca halmaturorum* tall shrubland) & Thr flora site (Salt Isotome)
128	2 C-L	103	15/03/2005	4	0	100		TVC TF	541646	6199483	Foster Rd	Low infestation risk, no native veg on rds, farmland adj. Near Thr. veg comm. (*E. camaldulensis* woodland) & Thr flora site (Salt Isotome)
129	2 C-LP	102	15/03/2005	1	0	100		TVC	539502	6184726	Mena Rd	Low infestation risk, farmland.Adj to Thr. veg comm.(*Allocasuarina verticillata* grassy low woodland, *E. camaldulensis* woodland, *Melaleuca uncinata* shrubland)
130	2 C-MP	101	15/03/2005	2	0	100		TVC	540242	6182010	Mena Rd/ ruins	Near Thr. veg comm. (*Allocasuarina verticillata* grassy low woodland).
131	2 C-LP	100	15/03/2005	1	0	100		TVC TF	536807	6182641	Farm Beach	Adjacent to Thr. veg comm.(*Baumea arthrophylla* sedgeland) & Thr flora site (Scaly Poa)
132	1 C-HP	99	15/03/2005	1	0	100		TVC TF CP	535424	6179148	Little Douglas	Adjacent to Thr. veg comm.(*Baumea arthrophylla* sedgeland) & Thr flora site (Scaly Poa), near Mt Dutton Bay CP.
133	2 C-LP	98	15/03/2005	40	0	100			541454	6181153	Flinders Hwy	Part of driveway windbreak
134	2 C-L	97	15/03/2005	200+	0	100			544293	6181516	Flinders Hwy	500m extent of mixed pines
135	2 C-HP	96	15/03/2005	3	0	100		R TF TVC HA	546650	6185581	Lady Franklin Rd	Near Thr Vegetation communities (*E. cladocalyx* woodland) & Thr Flora sites (Hop-bush Wattle), adj to signif rds veg in moderate-good condition. Near HA (Marble Range). Low infestation risk - wind row in paddock
136	2 C-HP	95	15/03/2005	50	0	100		R TF TVC	546763	6186372	Lady Franklin Rd	Adj Thr Flora site & Thr Vegetation communities (*E. cladocalyx* woodland) & Thr Flora sites (Hop-bush Wattle),, adj to signif rds veg in moderate-good condition. Near HA (Marble Range).Wind row in driveway
137	2 C-MP	94	15/03/2005	5	0	100		TVC	548509	6186925	Shepperd Rd	Near Thr Vegetation communities (*E. cladocalyx* woodland & *Melaleuca uncinata* shrubland).
138	2 C-LP	93	15/03/2005		0	100			553221	6190327	Shepperd Rd	Low infestation risk, wind row on farmland, approx 500m extent.
139	2 C-LP	92	15/03/2005	30	0	100			554115	6191226	Charlton	
140	2 C-LP	91	15/03/2005	6	0	100			552611	6173170	Flinders Hwy	Part of wind break in paddock.
141	2 C-LP	90	15/03/2005	6	0	100			553407	6172989	Flinders Hwy	In private driveway.
142	3 R-P	89	15/03/2005	20	0	100			563770	6167953		Trees around farm yard
143	3 R-P	88	15/03/2005	20	0	100			563995	6168057		Private land Shelter belt in driveway
144	2 C-LP	n/a	15/03/2005	5	0	100			565201	6167536	Mcfarlane Rd	Trees around driveway entrance
145	3 R-P	84	29/03/2005	7	0	100	Y		597183	6196658	Bratten Way	Shelter belt in paddock, low risk & EPYTBC feeding site.
146	2 C-L	83	29/03/2005	8	0	100	Y		596920	6196686	Bratten Way / Rd side	Roadside infestation, EPYTBC feeding site.
147	3 R-P	82	29/03/2005		0	100	Y		595662	6196918	Bratten Way	Private land, shelter belt approx 400m, EPYTBC feeding site
148	2 C-L	81	29/03/2005	15	0	100	Y		593668	6197130	Bratten Way	private or roadside? Shelter belt parallel to roadside. Potential for roadside infestation
149	2 C-LP	80	29/03/2005	10	0	100	Y		581938	6198962	Bratten way	Private, Shelter belt parallel to roadside.Potential for roadside infestation
150	3 R-P	79	29/03/2005	50	0	100			581419	6199012	Yallunda flat	
151	3 R	78	29/03/2005	80	0	100			581000	6198847	Yallunda flat / show ground	Council & community issues, history of showgrounds?
152	1 C-H	77	29/03/2005		0	100			579031	6193707	Yallunda flat/Koppio Rd	Early roadside infestation
153	3 R-P	76	29/03/2005	40	0	100			578926	6193326	Koppio	Shelter belt, private land
154	1 C-H	75	29/03/2005	15	0	100		TVC TF	566944	6191921	Koppio Rd / Edillilie	Adjacent to thr Flora site (Fat-leafed Wattle) & Thr veg comm (*Melaleuca uncinata* shrubland)

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155	1 C-H	74	29/03/2005	2	0	100			569147	6195084	Strawberry Hill Rd	Potential for roadside infestation
156	2 C-L	73	29/03/2005	20	0	100			568111	6198224	Strawberry Hill Rd	Trees around farm yard.
157	3 R-P	72	29/03/2005	30	0	100			567638	6200454	Marble View Rd	Shelter belt in paddock, approx 300m extent
158	3 R-P	71	29/03/2005	20	0	100			567256	6200527	Marble View Rd	Shelter belt in paddock
159	3 R-P	70	29/03/2005	300+	0	100	Y	TF	570395	6206237	Bratten way	Extensive shelter belts in cropped paddock & EPYTBC feeding site, but adjacent to 2x Thr Flora sites (Prickly Raspwort). Site to monitor for seedling spread
160	2 C-LP	69	29/03/2005	1	0	100		TF TVC	574726	6195145	Oleo Rd	Private land, one lone pine in paddock along driveway. Opportunity to remove seedlings, nearby Thr. veg comm.(*E. odorata+/- E. leucoxylon* grassy low woodland) & Thr flora site (Feathery Wattle)
161	2 C-LP	68	29/03/2005	15	0	100		TVC	573570	6165842	Hyde Rd	Adjacent to Thr. veg comm. (*E. cladocalyx* woodland), but shelter belt in middle of cropped paddock
162	2 C-LP	67	29/03/2005	100+	0	100	Y		574465	6166155	Hyde Rd	Adjacent to Thr. veg comm. (*E. cladocalyx* woodland), but shelter belt in middle of cropped paddock & EPYTBC feed site
163	2 C-LP	66	29/03/2005	6	0	100		TVC	573406	6161596	Wine Shanty Rd	Private land shelter belt right on roadside
164	3 R-P	65	29/03/2005	60	0	100			573198	6161900	Wine Shanty Rd	Shelter belt in paddock
165	2 C-LP	64	29/03/2005	200+	0	100			572224	6162829	Wine Shanty Rd	Large seeding trees
166	3 R-P	63	29/03/2005	50	0	100			572555	6163408	Wine Shanty Rd	Shelter belt along driveway
167	2 C-LP	62	29/03/2005	20	0	100			572198	6164219	Little Swamp l	Along roadside & many new seedlings maturing
168	2 C-LP	61	29/03/2005	10	0	100			572045	6163415	Little swamp	Along driveway
169	2 C-LP	60	29/03/2005	6	0	100			572027	6163084	Rose view Farm	
170	2 C-MP	59	29/03/2005	16	0	100			572165	6161851	Little Swamp	Shelter belt parallel to road
171	2 C-LP	58	29/03/2005	25	0	100			572230	6161660	Little Swamp	Shelter belt near house in paddock
172	2 C-L	57	29/03/2005	1000+	0	100			572302	6161451	Little Swamp	from highway to swamp
173	3 R	103	29/03/2005		0	100	Y		573733	6161309	Pt Lincoln Golf course	EPYTBC feed site, low infestation risk, regularly mowed
174	3 R-P	n/a	29/03/2005	3	0	100			573142	6161444	Flinders Hwy	
175	3 R-P	105	29/03/2005	5	0	100			573361	6161466	Little Swamp	
176	2 C-L	106	29/03/2005	4	0	100			573713	6162951	Chapman Rd	Roadside
177	3 R-P	107	12/04/2005	12	0	100			600347	6194704	Thuroona Rd	Shelter belt near house
178	1 C-HP	108 & 109	12/04/2005	60	0	100		TF TVC	596043	6187332	White River Rd	Driveway shelter belt, but adjacent to Thr Flora site (Whibley's Wattle) & Thr. veg comm. (*Melaleuca halmaturorum* tall shrubland)
179	2 C-MP	50	12/04/2005	75	0	100		TF	595092	6190160	Shram Rd	Shelter belt parallel to road & many small behind house. Nearby Thr flora site (Whibley's Wattle)
180	3 R-P	112	12/04/2005	100	0	100			594515	6192329	Lincoln Hwy Collandra	
181	3 R-P	114	12/04/2005		0	100	Y	TVC	594594	6195718	Sterling Rd crossing Bratten	EPYTBC feed site. 500m 0n Rd side + 300m row in paddock. Near Thr veg. comm. (*Allocasuarina verticillata* Grassy Low Woodland).
182	3 R-P	113	12/04/2005	150	0	100			595287	6194866	Durdins Rd	150 large around house
183	3 R-P	n/a	12/04/2005	17	0	100			593711	6193093	Cross Rd on Durdins	
184	3 R-P	115	12/04/2005	80	0	100			593208	6191584	Cross Rd on Durdins	
185	2 C-L	n/a	12/04/2005	15	0	100		TF	591984	6187781	Hammond Rd	no photo, private? Near Thr Flora site (Whibley's Wattle)
186	1 C-HP	118	12/04/2005	1	0	100		TF	593486	6187355		In grazed paddock but adjacent to Thr Flora site (Whibley's Wattle)
187	1 C-HP	120	12/04/2005	8	0	100		TF TVC	594081	6185597	Le Brunt Rd	In grazed paddock but adjacent to Thr Flora site (Whibley's Wattle) & Thr veg comm (*Melaleuca halmaturorum* tall shrubland). Problem - no other shade for stock?
188	1 C-HP	121	12/04/2005	6	0	100		TF	602220	6183320	Camp	Roadside, close to 3 x Thr Flora sites (Whibley's Wattle, Mallee Bitter-pea, Silvery Spyridium), has potential to spread.
189	2 C-LP	122	12/04/2005	6	0	100			589024	6187452	Lincoln Hwy/White River Rd	Several trees isolated in cropping paddock
190	2 C-LP	123	12/04/2005	18	0	100			583734	6177395	Lincoln Hwy/Louth bay turn	Shelter belt parallel to road
191	2 C-L	124	12/04/2005	9	0	100			580814	6173063	Hirschausen Rd	
192	3 R-P	125	12/04/2005	18	0	100			580185	6171772	Lincoln Hwy	
193	3 R-P	126	12/04/2005	40	0	100			578648	6166066	Southern Eyre Olives	Shelter belt in paddock
194	3 R-P	128	12/04/2005	1	0	100			577926	6162100	Richardsons Rd	
195	3 R-P	129	12/04/2005	5	0	100			577381	6162117	Richardsons Rd	
196	3 R-P	130 & 132	12/04/2005	100+	0	100	Y	TVC	557681	6171369	Flinders Highway The Fountain	EPYTBC feeding site. Near Thr veg. comm. (*E. cladocalyx* woodland).

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197	3 R-P	Toolilie Gully Rd	15/02/2005	7	50	50	Y	TVC HA	572500	6185300	Toolilie Gully Rd	EPYTBC feeding site. Near Heritage Agreement & Thr veg. Comm (*E. cladocalyx* woodland)
198	3 R	n/a			0	100	Y		578300	6161500	Port Lincoln Lions Park, east of Lincoln Hwy	EPYTBC feed site
199	3 R	n/a			0	100	Y	TVC	572000	6158000	Duck Ponds, sw of Pine freezer Rd	EPYTBC feed site, Near Thr veg. comm. (*E. camaldulensis* woodland).
200	1 C-H	99	21/02/2005	20	100	0	Y	TF TVC	562284	6171351	Borlase Rd / Rail way	Nearby Th flora site (Metallic Sun-orchid) & adjacent to Thr veg comm (*E. cladocalyx* woodland)
201	2 C-LB	98	21/02/2005	60	100	0			564225	6172049	Borlase Rd	
202	1 C-HP	95	21/02/2005	10	0	100		TF TVC CP, CR	557772	6174624	CK. 1km of Rd ?	Near Th flora site (Erect Sundew), Murrunatta CP & CR & Thr veg comm (*Melaleuca halmaturorum* tall shrubland & *Gahnia filum* sedgeland)
203	1 C-HP	94	21/02/2005	6	100	0		TF TVC CP, CR	554370	6176152	Settlers Rd	Near Th flora sites (Gimlet Bog-rush & Erect Sundew) & adj to Murrunatta CP & CR & Thr veg comm (*Melaleuca halmaturorum* tall shrubland & Gahnia filum sedgeland)
204	2 C-LP	n/a	21/02/2005	20	20	80			559293	6184772	Warunda Rd	
205	3 R-P	86	22/02/2005	30	95	5			558225	6184504	Warunda Rd	hedge row in paddock, low risk
206	3 R-P	85	22/02/2005	6	0	100			556051	6184504	Warunda Rd	
207	3 R-P	80	22/02/2005	20	20	80			578125	6170651	Murray Rd	
208	3 R-P	80a	28/02/2005	1	0	100	Y		584695	6194630	Pillaworta Rd	Low risk, in paddock.EPYTBC feed site
209	2 C-LP	62	14/02/2005	50	90	10	Y	TVC	571249	6168577	Wine Shanty Rd	Private land: roadside drive + behind house , adjacent to Thr. veg comm. (*E. cladocalyx* woodland)
210	2 C-LB	40	15/02/2005	5	0	100			579431	6185156	White Flat Rd	
211	3 R-P	63	14/02/2005	7	5	95		TVC	571835	6168577	Glen Forest Animal Park	Near to Thr. veg comm. (*E. cladocalyx* woodland)
212	2 C-L	n/a	15/02/2005	50	0	100			578283	6183164	Todd Res	
213	2 C-L	64	14/02/2005	10	90	10			571094	6170009	GreenPatch Rd?	Roadside
214	3 R	36	15/02/2005	6	100	0		TVC	563643	6178833	Charlton Gully Rd	EPYTBC breeding area. Near Thr veg comm (*Gahnia filum* sedgeland ?)
215	3 R	65	14/02/2005	1	0	100		TVC	570836	6172173	Driveway	EPYTBC breeding area Near Thr veg comm (*E. cladocalyx* woodland)
216	2 C-L	35	15/02/2005	20	0	100			564851	6191286	Edillilie Todd Hyw	
217	3 R	n/a	14/02/2005	2	50	50		TVC	571108	6172835	Moody Lane	EPYTBC breeding area Near Thr veg comm (*E. cladocalyx* woodland)
218	2 C-L	34	15/02/2005	20	20	80			563924	6188718	Todd Hyw	Landholder already removed?
219	3 R	n/a	14/02/2005	20	0	100	Y	TVC	568630	6174855		EPYTBC breeding area Near Thr veg comm (*E. cladocalyx* woodland)
220	1 C-H	33	15/02/2005	60	100	0		TF TVC CP, CR	555954	6174763	Merintha Creek Rd	Near Th flora sites (Gimlet Bog-rush & Erect Sundew) & adj to Murrunatta CP & CR & Thr veg comm (*Melaleuca halmaturorum* tall shrubland & Gahnia filum sedgeland)
221	3 R	n/a	14/02/2005	2	100	0	Y	TVC	567676	6175138		EPYTBC breeding area Near Thr veg comm (*E. cladocalyx* woodland)
222	2 C-LP	n/a	21/02/2005	3	44	56			568052	6170163	McFarlane Rd	Private. No photo
223	3 R	57a	14/02/2005	24	100	0	Y	TVC	567165	6176756	Wattle drive / Charlton gully	EPYTBC breeding area Near Thr veg comm (*E. cladocalyx* woodland)
224	2 C-LP	n/a	21/02/2005	30	94	6			569187	6170233	McFarlane Rd	Private. No photo
225	3 R	57b	14/02/2005		95	5	Y	TVC	567323	6176831	Charlton gully Rd	300m extent, EPYTBC breeding area. Near Thr veg comm (*E. cladocalyx* woodland)
226	1 C-H	n/a	13-Jul-2004	1	0	100	Y	TVC	548778	6152401	Uley Basin	Controlled by SA Water in 2005? Near Thr veg comm (*Allocasuarina verticillata* grassy low woodland)
227	3 R	55	14/02/2005	8	97	3	Y	TVC	568659	6176822		EPYTBC breeding area Near Thr veg comm (*E. cladocalyx* woodland)
228	3 R	n/a	5-Aug-2004	1	0	100	Y	TVC TF	561229	6166689	Uley Basin	EPYTBC feeding site 03-04. Near Thr flora sites (Hop-bush Wattle, Twisted Sun-orchid) & Thr veg comm (*Allocasuarina verticillata* grassy low woodland)
229	3 R	54	14/02/2005	4	100	0	Y	TVC	572572	6177698	Pope Lane	EPYTBC breeding area Near Thr veg comm (*E. cladocalyx* woodland)
230	3 R	n/a	24-Aug-2004	1	0	100	Y	TVC TF	559100	6168891	Uley Basin	EPYTBC feeding site 03-04 Near Thr flora sites (Hop-bush Wattle, Twisted Sun-orchid) & Thr veg comm (*Allocasuarina verticillata* grassy low woodland)
231	3 R	n/a	14/02/2005	4	20	80	Y	TVC	567937	6178701	Bald hill Rd	EPYTBC breeding area Near Thr veg comm (*E. cladocalyx* woodland & *Allocasuarina verticillata* grassy low woodland)

REF	PRIORITY	PHOTO ID	DATE	No. PINES	% BURNT	% UNBUNRT	EPYTBC Feeding	Other biodiversity significance	Easting*	Northing	LOCATION	NOTES
232	3 R	n/a	24-Aug-2004	1	0	100	Y	TVC TF	559145	6168899	Uley Basin	EPYTBC feeding site 03-04 Near Thr veg comm (*Allocasuarina verticillata* grassy low woodland & *E. camaldulensis* woodland) & Thr flora site (Metallic Sun-orchid)
233	3 R	52	14/02/2005	3	0	100	Y		568745	6189712	Bald hill Rd	EPYTBC feeding site
234	3 R	n/a	24-Aug-2004	2	0	100	Y		559097	6168875	Uley Basin	EPYTBC feeding site 03-04 Near Thr veg comm (*Allocasuarina verticillata* grassy low woodland & *E. camaldulensis* woodland) & Thr flora site (Metallic Sun-orchid)
235	2 C-LBP	51	15/02/2005	1	100				562706	6175130	Todd Highway	Private
236	3 R	n/a	24-Aug-2004	1	0	100	Y	TVC TF	559597	6169582	Uley Basin	EPYTBC feeding site 03-04 Near Thr veg comm (*Allocasuarina verticillata* grassy low woodland & *E. camaldulensis* woodland) & Thr flora site (Metallic Sun-orchid)
237	2 C-LP	50	15/02/2005	20	50	50			560697	6175959	Todd Highway	Private
238	3 R	n/a	24-Aug-2004	1	0	100	Y	TVC TF	559857	6169780	Uley Basin	EPYTBC feeding site 03-04 Near Thr veg comm (*E. camaldulensis* woodland & *Allocasuarina verticillata* grassy low woodland) & Thr flora site (Metallic Sun-orchid)
239	1 C-HP	49a	15/02/2005	23	0	100		TVC TF	560745	6177768	Todd Highway	Private. Adjacent to EPYTBC breeding area, but also adjacent to Thr. veg comm.(*E. cladocalyx* woodland) & Wanilla Settlement reserve & Thr Flora site (Metallic Sun-orchid)
240	3 R	n/a	24-Aug-2004	1	0	100	Y	TVC TF	559556	6167785	Uley Basin	EPYTBC feeding site 03-04 Near Thr flora sites (Hop-bush Wattle, Twisted Sun-orchid) & Thr veg comm (*Allocasuarina verticillata* grassy low woodland)
241	1 C-H	n/a	15/02/2005	10	0	100		TVC TF	561495	6178840	Todd Highway	Landholder already removed. Private. No photo. Adjacent to EPYTBC breeding area, but also adjacent to Thr. veg comm. .(*E. cladocalyx* woodland & Wanilla Settlement reserve & Thr Flora site (Metallic Sun-orchid)
242	3 R	n/a	24-Aug-2004	1	0	100	Y	TVC TF	559543	6167858	Uley Basin	EPYTBC feeding site 03-04 Near Thr flora sites (Hop-bush Wattle, Twisted Sun-orchid) & Thr veg comm (*Allocasuarina verticillata* grassy low woodland)
243	2 C-MB	n/a	15/02/2005	2	100	0	Y	TF TVC	562254	6179652	Wanilla Township	Thr. veg comm. .(*E. cladocalyx* woodland & Wanilla Settlement reserve & Thr Flora site (Metallic Sun-orchid).
244	3 R	n/a	24-Aug-2004	1	0	100	Y	TVC TF	559160	6168743	Uley Basin	EPYTBC feeding site 03-04 & 05-06 Near Thr veg comm (*E. camaldulensis* woodland & *Allocasuarina verticillata* grassy low woodland) & Thr flora site (Metallic Sun-orchid)
245	1 C-HP	46	15/02/2005	100	44	56			562171	6179652	Todd Highway	Private
246	3 R	n/a	24/02/2004	6	100	0	Y	TF	559133	6171428	Wanilla Forest	Wanilla Forest pines near old EPYTBC aviary, all burnt. Near Thr flora site (Metallic Sun-orchid)
247	3 R	44 & 45	15/02/2005	30	100	0			564087	6181089	Todd Highway	EPYTBC breeding area
248	3 R	n/a	24/02/2004	12	100	0	Y	TF	558883	6171707	Wanilla Forest	Wanilla Forest pines near main cottage site, all burnt. Near Thr flora site (Metallic Sun-orchid)
249	3 R-P	43	15/02/2005	7	0	100			561649	6184126	Todd Highway	Private.
250	3 R	n/a	24/02/2004	30	100	0	Y	TF	558984	6171685	Wanilla Forest	Wanilla Forest pines near main cottage site, all burnt. Near Thr flora site (Metallic Sun-orchid)
251	3 R	n/a	24/02/2004	30	100	0	Y	TF	558926	6171680	Wanilla Forest	Wanilla Forest pines near main cottage site, all burnt. Near Thr flora site (Metallic Sun-orchid)
252	3 R		15/02/2005	4	0	100	Y		572708	6185224	Toolilie Gully Rd	EPYTBC breeding area
253	3 R	n/a	24/02/2004	30	100	0	Y	TF	558908	6171676	Wanilla Forest	Wanilla Forest pines near main cottage site, all burnt. Near Thr flora site (Metallic Sun-orchid)
254	1 C-H	n/a	15/02/2005	15	0	100		HA TF	574727	6188154	Toolilie Gully Rd	Near Heritage Agreement & near Thr flora site (Metallic Sun-orchid, Imbricate Wattle)
255	1 C-H	40	15/02/2005	5	0	100	Y	HA TF	574902	6187935	Growdens Rd / Road side	Near Heritage Agreement & near Thr flora site (Metallic Sun-orchid, Imbricate Wattle)
256	3 R-P	39	15/02/2005	10	0	100	Y		575662	6187096	Growdens Rd	
257	3 R	n/a	15/02/2006				Y	TVC	575970	6189459	Dennis Rd	Roadside/private shelterbelt 2006 EPYTBC feeding record Near Thr veg comm (*E. cladocalyx* woodland ?)
258	3 R-P	n/a		20				TVC	57897	619361	Yallunda Flat Rd	Shelter belt along driveway 2004 potential (unconfirmed)EPYTBC feeding record Near Thr veg comm (*E. cladocalyx* woodland ?)

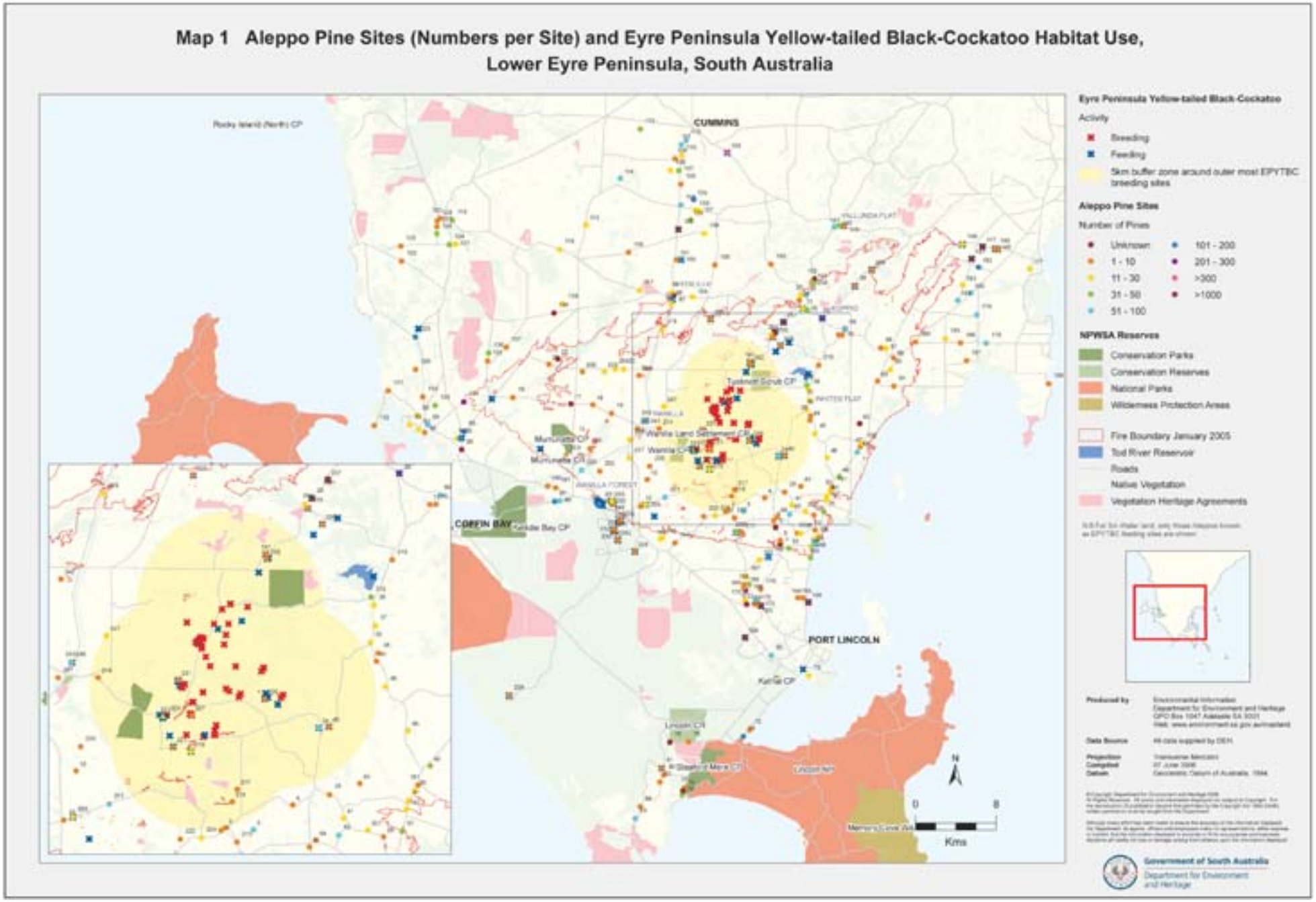
APPENDIX 4: MAPS

Map 1 Aleppo Pine sites (numbers per site) and Eyre Peninsula Yellow-tailed Black-Cockatoo habitat use, Lower Eyre Peninsula, South Australia

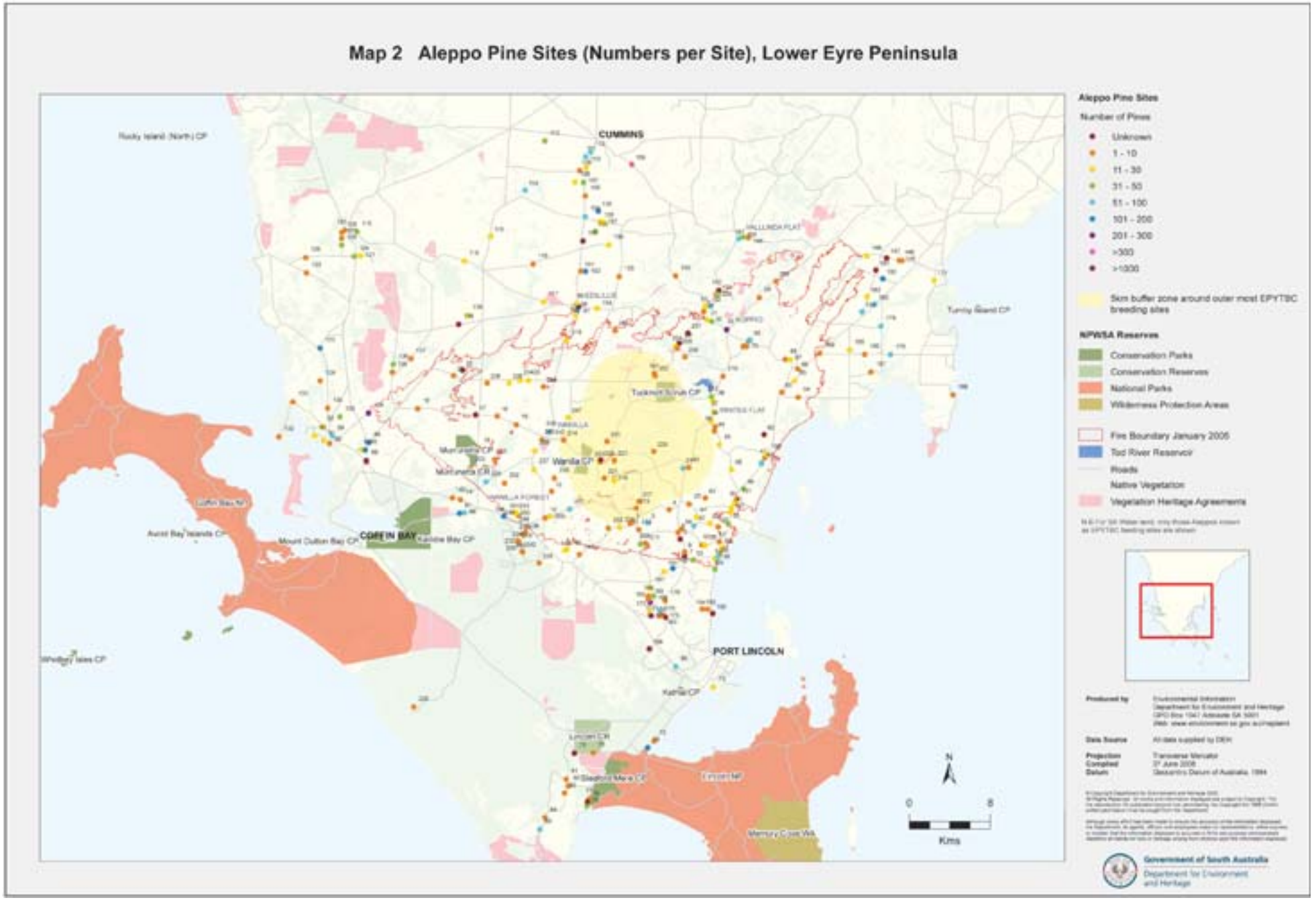
Map 2 Aleppo Pine sites (numbers per site), lower Eyre Peninsula

Map 3 Aleppo Pine sites (percentage burnt), lower Eyre Peninsula

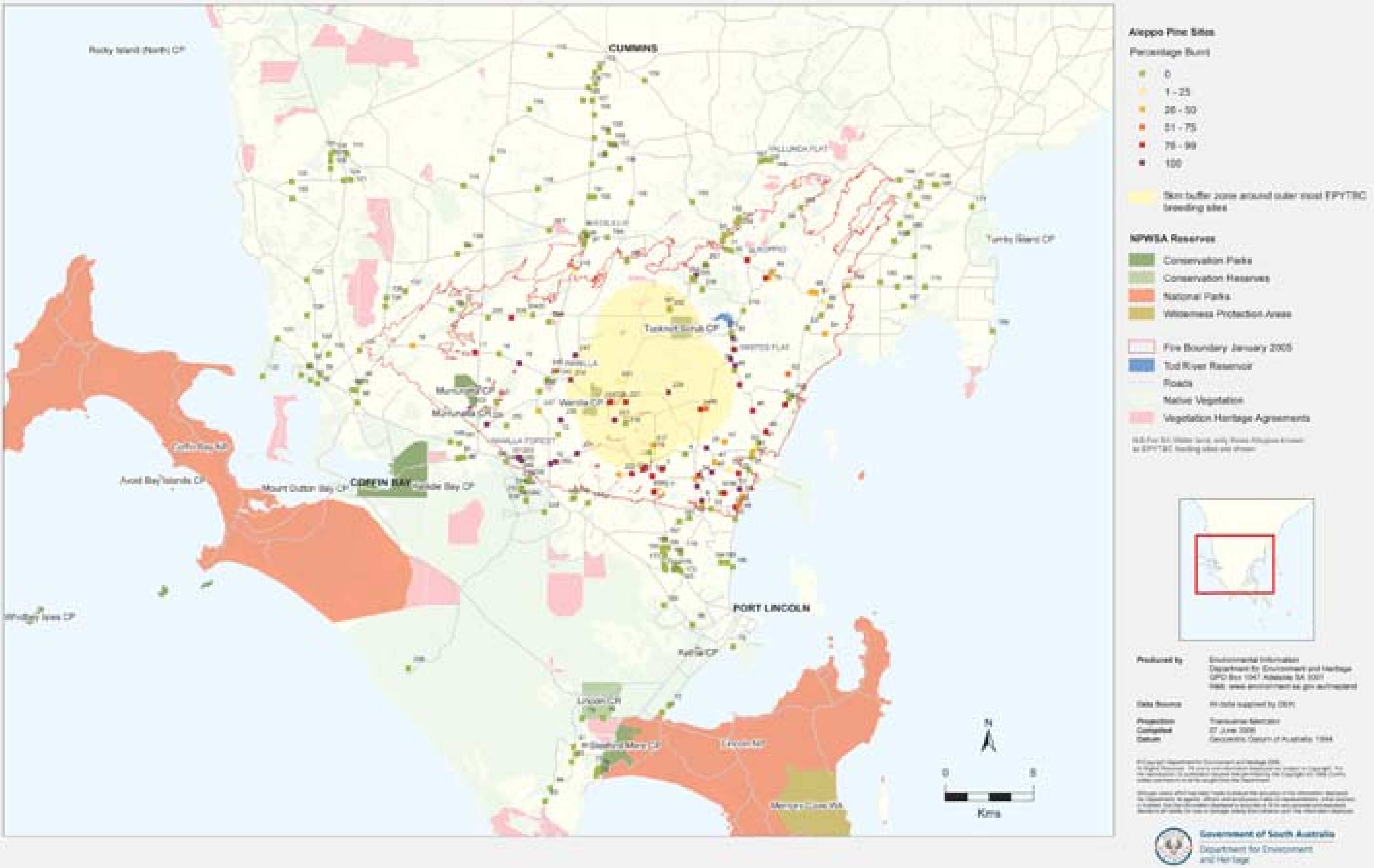
Map 4 Aleppo Pine control boundary and priority sites, Lower Eyre Peninsula.3


Map 1 Aleppo Pine Sites (Numbers per Site) and Eyre Peninsula Yellow-tailed Black-Cockatoo Habitat Use, Lower Eyre Peninsula, South Australia
CUMMINS
COFFIN BAY
PORT LINCOLN
Eyre Peninsula Yellow-tailed Black-Cockatoo
Activity
Breeding
Feeding
5km buffer zone around outer most EPYTBC breeding sites
Aleppo Pine Sites
Number of Pines
Unknown
1 - 10
11 - 30
31 - 50
51 - 100
101 - 200
201 - 300
>300
>1000
NPWSA Reserves
Conservation Parks
Conservation Reserves
National Parks
Wilderness Protection Areas
Fire Boundary January 2005
Tod River Reservoir
Roads
Native Vegetation
Vegetation Heritage Agreements
Kms
Government of South Australia
Department for Environment and Heritage

Map 2 Aleppo Pine Sites (Numbers per Site), Lower Eyre Peninsula



Map 3 Aleppo Sites (Percentage Burnt), Lower Eyre Peninsula



Map 4 Aleppo Pine Control Boundary and Priority Sites, Lower Eyre Peninsula