

Re-evaluation of the Bitter-bush Blue Butterfly (*Theclinesthes albocinctus*) and Coast Bitter-bush (*Adriana quadripartita*) Distributions

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Photo: Theclinesthes albocinctus, credit Matt Endacott

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Summary

This report presents successive re-evaluations of the Bitterbush blue butterfly (*Theclinesthes albocinctus*) and its larval host plant, the Coast bitter-bush (*Adriana quadripartita*) in coastal areas from Parham to Normanville as well as inland locations of Tatachilla and McLaren Vale.

The findings of butterfly populations and the Coastal Bitter-bush from visits undertaken in 2023 are assessed and presented together.

This report supersedes the Re-evaluation of Bitterbush blue butterfly (*Theclinesthes albocincta*) and Coast Bitter-bush (*Adriana quadripartita*) Distribution Report V 2.0 December 2022 (Stolarski A. (2022).

Four new translocation sites are presented which include Largs North dunes, Barker Inlet at Dry Creek, Hackham Creek at Noarlunga and Coast to Vines Rail Trail at McLaren Vale.

The translocation outcomes of the Bitterbush blue butterfly in two metropolitan areas, Minda Dunes and Moana Sands Conservation Park are discussed.

Butterfly colonies, as described in the Bitterbush blue butterfly (BBB) Action Plan (Glatz *et. al* 2017), were found persisting and show similar population densities.

The butterfly population densities are strongly associated with *Adriana* abundance and plant health.

Priority actions and specific site recommendations are outlined.

A "Guide to successful growing of *Adriana quadripartita*" and "Landscape uses" is provided in Appendix 1 & 2.

Bitterbush Blue Butterfly

The Bitterbush blue butterfly (BBB) (*Theclinesthes albocinctus*) is widely distributed throughout most of South Australia where *Adriana* species occurs. Larvae of BBB feed exclusively on *Adriana* species and use *Adriana* quadripartita in coastal areas. The BBB predominantly occurs as "blue" colour forms along the coastal areas with "brown" colour forms occurring in drier inland areas and exhibit seasonal variation (Fig. 1-3).

Inland "brown" colour forms have been recorded from coastal areas; however these are less frequently encountered (Stolarski & Meyer 2015).

The BBB, although a small butterfly, is a remarkably strong flyer capable of dispersive flights as with other *Theclinesthes* species. It is usually encountered where its larval plant is present with adults sometimes seen nectaring on flowers away from such areas.

The BBB is able to persevere in areas with low *Adriana* plant numbers and/or older plants being able to sustain low populations on one or two bushes.

The BBB exhibits temporary population number explosions in post disturbance *Adriana* plant sites and then subsides in numbers once plant maturity is attained.

The butterfly has none known parasitic associations.

The BBB exhibits seasonal morphological variations and variable population densities resulting from environmental conditions.



Figure 1. Coastal blue form.



Figure 2. Coastal brown form.



Figure 3:. Coastal intermediate form.

Coast Bitter-bush

The Coast bitter-bush (*Adriana quadripartita*) is a hardy plant tolerant of many harsh environmental conditions and can be found growing in coastal and mallee areas. The plant is usually found growing in open sunny positions associated with well drained soils such as alkaline sands and limestone.

Adriana can grow in most soil types when planted, subject to water availability.

Soil hydrology influences the appearance of the plants with well hydrated plants displaying larger lush green leaves and higher growth rates compared to stressed plants with narrowed leaves with a stalky appearance (Fig. 4 & 5).

The plant will successfully grow as a hedge in revegetation with mulch and as an ornamental in large containers.

The plant produces seeds with physiological dormancy that requires it to be broken for seed germination to occur. This allows for seed longevity with soil disturbances often triggering good germination and subsequent lush growth (Fig 6 & 7).

Established plants respond positively to trimming and slashing.



Figure 4. *Adriana* plant displaying lush growth.



Figure 6. Post disturbance Adriana germination.



Figure 5. Adriana displaying stalky appearance.



Figure 7. Post disturbance Adriana growth.

Survey Methodology

Sites were visited during 2023 period with some receiving multiple visits.

Surveys of the BBB were conducted by observing flying adults, searching for larval activity and/or eggs on plants.

Plants were noted for their overall appearance and distribution within sites.

New sites of remnant or planted *Adriana quadripartita* were assessed for their suitability as BBB host sites.

Compilation of all known coastal *Adriana* sites from Parham to Hindmarsh Island is currently being undertaken and will provide an up-to-date dataset for future surveys, translocations, and site management.

Bitterbush Blue Butterfly Sites

Currently 16 sites (Fig. 8) are being monitored for the BBB and are listed as follows:

- **A** Parham and Webb Beach
- **B** Port Gawler
- C Biodiversity Park, Mutton Cove, Torrens Island, Largs North dunes and Barker Inlet
- **D** Minda Dunes
- **E** Moana Sands CP, G. Rabbett Res., Hackham Creek, Branson Rd. Res. and Coast to Vines Rail Trail
- **F** Normanville Dunes and Lady Bay



Figure 8. Bitter Bush Blue Butterfly Sites.

Six sites support a self-sustaining BBB population: Parham, Webb Beach, Port Gawler, Torrens Island, Coast to Vine Rail Trail site and Lady Bay.

Two sites are known to support BBB populations periodically: Biodiversity Park and Mutton Cove.

Three sites supported temporary BBB populations post translocations but failed to establish: Minda Dunes, Moana Sands CP and Graham Rabbett Reserve.

Hackham Creek survey failed to find evidence of BBB, however localised environmental conditions may be at play with BBB present as pupae awaiting emergence.

One site, Normanville Dunes supported a self-sustaining population until the larval host plant *Adriana* died due to unsuitable soils.

Two sites were the recipients of translocated larvae in December 2023: Largs North Dunes and Barker Inlet.

One site, Branson Road Reserve at Tatachilla is being monitored as a potential release site in the future.

Parham

Parham sites continue to support the major most northern Adelaide plains BBB population predominantly in areas with younger *Adriana* plants. This colony adjoins Webb Beach colony and are isolated from other disjunct populations further south by intertidal areas with no known *Adriana* stands.

Parham being the main BBB population site, supporting large *Adriana* stands in areas northeast of the township, is the strong hold for this species (Fig. 9). This area contains plants at various stages of growth with adult butterflies, larvae, and eggs (up to 10 eggs per flower stalk) being observed in high numbers. Majority of the egg and larval activity was noted on younger male plants with flying adults present in their proximity.

Majority of *Adriana* plants to the south of Parham's sports and social club site are senescing with evidence of larval activity present on the smaller, lusher plants as a result of slashing activities (Fig. 10).



Figure 9. Parham, NE of township site.



Figure 10. Parham, sports and social club site.

The area provides an opportunity to enhance the *Adriana* stands either through further plantings or soil disturbances for seed germination.

Recent visits to Parham found that the stronghold population area northeast of the township has been impacted by an arson fire in November 2023, resulting in approximately 80% of *Adriana* stands being burnt (Fig. 11).



Figure 11. Parham burnt area, NE of township site. Photo credit: Danny Millbanks.

Further damage to the area was observed with plant removal due to fire break constructions. This disturbance will aid in natural regeneration of plants in the longer term as *Adriana* seeds respond well to soil disturbance.

An assessment of burnt *Adriana* plants found that post fire regeneration is notably occurring.

In the short term this has substantially impacted BBB planned translocation works into Adelaide's metropolitan site of Minda Dunes and Moana Sands CP.

Post fire monitoring for regrowth and BBB recolonisation is recommended.

Webb Beach

Webb Beach supports a small persistent colony of butterflies on a number of isolated *Adriana* plants. This colony has been observed over several years (2016-2022) (A. Stolarski pers. obs.) and found that population numbers fluctuate seasonally.

During some site visits no evidence of BBB being present was found. The use of younger plants is again being favoured at this site especially slashed plants growing on the sides of road within the township. Plants pictured are subject to periodic roadside slashing (Fig. 12).



Figure 12. Webb Beach, roadside site.

Port Gawler

Port Gawler is an extensive *Adriana quadripartita* site with a strong BBB population (Fig. 13).

Adults, larvae and eggs were observed in good numbers during December 2021. The use of male flower spikes for butterfly ovipositing (egg-laying) and larval activity is noted as preference for this site.

Adriana is found growing in shell grit and sandy areas with seed germination evident in shell grit/sand mix soils only (Fig. 14 & 15). These young plants will complement the senescing plants that were extremely stressed during 2016-2020 (A. Stolarski pers. obs.).

Stressed plants have recovered following substantial rain events during 2021 that also triggered *Adriana* germination observed in December 2021 (Fig. 16).

The site visit during December 2023 found good, lush plant growth supporting a healthy BBB population. Butterfly ovipositing was observed with large number of juvenile larvae present.



Figure 13. Port Gawler Site



Figure 14. Port Gawler, shell grit area.



Figure 15. Port Gawler, young plant



Figure 16. Port Gawler, Young Adriana circled red.

Torrens Island and Le Fevre Peninsula Sites

Torrens Island

As noted in the BBB Action Plan, this Torrens Island population was the last substantial population remaining along the Metropolitan coastline. The BBB colony was assessed in April, October, December 2021 and again in March 2022 and found population numbers to be low.

Adriana plants are growing amongst scattered Wattles (Acacia spp.) associated with Perennial veldt grass (Ehrharta calycina). The BBB Action Plan notes a level of threat to this colony;" most of the plants are old and subject to heavy pressure from grass, and fire has a high chance of removing the entire Adriana patch". As-to-date this situation has not changed (Fig. 17).

The BBB population persists in low numbers under these conditions, however may be increased through the rejuvenation of *Adriana* plants and reduction of grass biomass. Established *Adriana* plants growing at the AGL power station entrance in the landscaped gardens were surveyed, however no BBB was found present.

Small numbers of *Adriana* were planted in sandy areas of Torrens Island Conservation Park but have failed to establishment.

Future plantings and consideration for site selection based on preferred soil type are recommended. Refer to "A guide to successful growing of Adriana plants" (Appendix 1).



Figure 17. Torrens Island.

Biodiversity Park

Biodiversity Park contains a mixture of mature and newly planted *Adriana* plants. The recent plantings growing in the south eastern corner of the park appear to be establishing slowly with no larval activity.

Isolated evidence of larval activity was found on the larger well established *Adriana* plants suggesting a low BBB population presence (Fig. 18).

Adult butterflies observed in 2021 appear to be in low numbers (M. Endacott, pers. obs). It is recommended that further *Adriana* plantings be undertaken throughout suitable areas within the park away from the current *Adriana* stands. This will provide a scattered distribution of larval host plants within the park allowing for greater BBB distribution.

A survey was undertaken in March 2023 to determine the impacts of the proposed major road works on *Adriana quadripartita* and BBB at Biodiversity Park and

adjoining Kardi Yarta. The survey found that concept modelling of proposed road works will have an impact on both the butterfly and its larval host plant *Adriana* at Biodiversity Park.

The survey of adjacent Kardi Yarta site found *Adriana* plants in poor health and unsuitable for use by the BBB.

The complete assessment of the proposed roadwork impacts will not be known until the Department for Infrastructure & Transport releases the final works layout.

Biodiversity Park was found to support the Bitterbush Blue Butterfly with evidence of larval leaf scour.



Figure 18. Biodiversity Park.

Largs North Dunes

The Largs North Dunes site was visited in 2021 due to its proximity of BBB colonies at Biodiversity Park and Torrens Island. Three mature planted *Adriana's* are growing in a semi open habitat suitable for the BBB, however its presence was not found in 2023.

This site has been subject to increased *Adriana* plantings in June 2022 with many plants reaching suitability for translocation of BBB (Fig. 19).

A translocation was undertaken on the 6th December 2023 with 20 larvae released from Parham population (Fig. 20). Additionally 5 male flower spikes containing uncounted eggs and juvenile larvae within flower buds were attached to the plants.



Figure 19. Taperoo Dunes plantings 2022.



Figure 20. Larval translocation, Derek Tyndall (PAE).

Mutton Cove

Mutton Cove area was surveyed in February 2023 and found to support a small number of *Adriana* plants growing on the south facing verge of a tidal mitigation levee bank in shell grit sandy soil (Fig. 21).

No evidence of BBB was found.

Whist this is a small site it plays an important role as a "*stepping stone*" for BBB movement between Torrens Island and Biodiversity Park and forms part of Le Fevre Peninsula's BBB meta-population habitat.



Figure 21. Mutton Cove Adriana, February 2023.

Barker Inlet

Barker Inlet site has been the recipient of 45 Adriana plants in Winter 2022.

Twenty-six plants have reached suitability as larval host plants (Fig. 22).

Translocation of BBB was undertaken on the 6th December 2023 with 21 larvae released onto male *Adriana* plants from Parham population. Additionally 5 male flower spikes containing uncounted eggs and juvenile larvae within flower buds were attached to the plants.



Figure 22. Barker Inlet plantings.

Minda Dunes

Minda Dunes area was assessed on 26th November 2021 and deemed as a potential trial release site for BBB. This assessment recommended larvae be introduced from suitable donour sites with larvae being sourced from Parham and Port Gawler populations.

Minda Dunes, considered as an open site contains a small number of Adriana plants in various stages of growth, providing ideal habitat for a BBB colony (Fig. 23).

Larvae were translocated in December 2021 and subsequent adults were observed in January 2022 (Fig. 24).

A survey in March 2022 found larvae present indicating a breeding population.

A further survey undertaken on the 7th December 2022 failed to locate adults, eggs or larvae, however minor evidence of larval activity was noticed on male flower buds. This evidence however does not support a sustainable population at site.

Subsequent multiple surveys during 2023 found no evidence of BBB presence.

The site has been enhanced with additional *Adriana* plantings and supplemented with mulch to increase soil water retention and provide suitable BBB pupation environment.

Additional watering of plants is undertaken on a semi regular basis by the Friends of Minda Dunes members.



Figure 23. Minda Dunes site.

Figure 24. Minda Dunes, larval host plant.

Moana Sands Conservation Park

Moana Sands CP supports a small number of planted *Adriana* plants consisting of 3 mature and 20 young plants (Fig. 25 & 26).

BBB larvae were translocated onto young leaves and flower spikes on the 15th December 2021. Eggs laid on flower buds were observed on the 14th January 2022 indicating an initial successful translocation outcome (M. Endacott pers. obs.).

A survey undertaken on the 7th December 2022 failed to locate adults, eggs or larvae, however minor evidence of larval activity was noticed on male flower buds.

The site has been further enhanced with additional *Adriana* plantings in June 2022 with the plants yet to reach suitability for BBB larval use.



Figure 25. Moana Sands CP, BBB release site.



Figure 26. Moana Sands CP, BBB larval plants.

Graham Rabbett Reserve

Post translocation of BBB into Moana Sands CP and observation of the butterfly's breeding was seen at Graham Rabbett Reserve, some 600 m to the south of the release site (Fig. 27).

Larval presence was observed on two planted *Adriana* bushes in the council's Reserve on the 1st April 2022 (Fig. 28) (M. Endacott pers. obs.).

The Graham Rabbett Reserve survey undertaken on the 7th December 2022 failed to locate adults, eggs or larvae and no evidence of larval activity was noticed.

Additional complimentary *Adriana* plantings were undertaken at Graham Rabbett Reserve during the winter months of 2022 and 2023.



Figure 27. Graham Rabbett Reserve site.



Figure 28. Graham Rabbett Reserve, larval activity.

Hackham Creek

Hackham Creek site supports a remnant stand of *Adriana quadripartita* plants comprising of 50+ young and old individuals. Being a small site, plants are restricted to soil type comprising of a limestone outcrop situated on a southern slope (Fig. 29).

Plants are well hydrated and display active growth and both male and female plants are well represented.

The *Adriana* stands are surrounded by native and non-native grass species and substantial areas of *Scabiosa atropurpurea* (Fig. 30).

No evidence of BBB was found present during the initial site assessment, however this site demonstrates as highly suitable for the introduction of the butterfly.

Translocation of 83 BBB larvae from Parham and Port Gawler populations was undertaken during December 2022.

The post translocation survey found adults and larvae present in March 2023 indicating a successful outcome.

A survey undertaken in October and November 2023 failed to find evidence of BBB.

It is recommended that opportunistic spot surveys be conducted during January to March 2024 to establish evidence of BBB's presence. Failing the findings of the BBB, another translocation is recommended.



Figure 2. Hackham Creek stands.



Figure 30. Male Adriana plant.

The adjacent area directly west of this site located within Onkaparinga River Recreation Park was assessed as a potential site for *Adriana* plantings. A small planting of 30 *Adriana* plants was undertaken in June 2023. The plants were severely affected by heat during spring of 2023 with 10 plants currently surviving. It is recommended that plantings coincide with first autumn rains of 2024 as to enhance root establishment.

Both areas were assessed for BBB habitat enhancement in September 2023 and further planting recommendations are presented (Fig. 31).



Figure 31. Hackham Creek, current and proposed Adriana quadripartita stands.

Coast to Vines Rail Trail

A disused railway line corridor refurbished into a walking/bike riding trail, known as Coast to Vines Rail Trail, supports approximately 150+ *Adriana quadripartita* plants. These plants comprise of remnant, naturally regenerating and planted stands growing along a 270 m stretch on both sides of the trail.

The plants are found in all stages of growth from seedlings to mature individuals and are subject to slashing periodically through trail maintenance activities. Natural water run-off provides moisture to the actively growing stands of both male and female plants (Fig. 32 & 33).

Previous recommendations of BBB introductions into this site with translocation of 100 larvae occurred during December 2022 from Parham and Port Gawler populations.

Post introduction was also recommended and that advisory signage be erected at both ends of the *Adriana* stands highlighting the BBB and its exclusive use of *Adriana*.

A post translocation survey was undertaken during March 2023 with both adults and larvae found present in good numbers. A further survey undertaken during October and November 2023 confirmed the successful establishment of BBB with adults found present.

The site was subjected to annual path maintenance resulting in mechanical trimming of *Adriana* plants (Fig. 34). The timing of this activity unfortunately coincided with the flight and egg laying period of the BBB cycle resulting in negative population impact through the reduction of eggs and juvenile larvae.

It is recommended that path maintenance be undertaken during late winter to early spring periods when the BBB is present as pupae. Pupation occurs in leaf litter at bases of host plants and may not be subjected to destruction.

Advisory signage is yet to be erected and improved communication with relevant stakeholders is required to avoid negative impacts on the BBB population at this site.



Figure 32. Trail with Adriana plants present both side.



Figure 33. Healthy well hydrated Adriana plant.



Figure 34. Adriana trimming along path. Photo credit: Matt Endacott.

Normanville Dunes

BBB were found at Normanville Dunes during the survey in March 2022 on planted *Adriana* in the re-vegetation area with a small number of mature larvae present (Fig. 35 & 36).

Many of the *Adriana* plantings in this area were found dead displaying characteristics of water stress. Although some plants have established, allowing for BBB presence, the sandy soils in this stretch of revegetation area are generally unsuitable for long term survivorship of *Adriana*.

A visit to the site in September 2022 showed evidence of BBB with larval chew marks present on one of two living plants.

A further visit to site in October 2023 failed to find live *Adriana* plants resulting in the collapse of the BBB population.

Additional Adriana plantings are recommended at this site in suitable soils.



Figure 35. Normanville Dunes, revegetation area.



Figure 36. Normanville Dunes, Mature BBB larva.

Lady Bay

The Lady Bay site, within the Normanville South Dunes system is the largest southern *Adriana* stand in the survey area with approximately 50 plants. Majority of *Adriana* plants are senescing with some dead due to age and vegetation encroachment. Mature plants are stalky in appearance with low green leaf matter and are displaying signs of water stress (Fig. 37).

BBB were found present at this site with both larvae and eggs sighted but were confined to healthier plants (Fig. 38).

This BBB population is deemed low in numbers attributed to the state of *Adriana* plants. Additional plantings or the rejuvenation of older plants is required to enhance the BBB population.

Recent *Adriana* plantings located along the Main South Road roadside revegetation strip near the corner of Lady Bay Road were also examined and BBB larval activity was found present. This indicates a natural colonisation of this area.

The *Adriana* remnant plants at Lady Bay site have a unique round leaf form and should be used as a source of provenance for future revegetation and rehabilitation works in the district.



Figure 37. Lady Bay, old Adriana plants.



Figure 38. Lady Bay, larval activity.

Potential Translocation Site

Branson Road Reserve

Branson Road site supports a small number of 15+ scattered Adriana quadripartita plants growing on the western slopes within the road reserve. Many individual plants are crowded by revegetation specifically from direct seeded species including Acacia *sp*. The western end of this road reserve contains isolated mature Adriana plants which are watered regularly via run off.

Possible evidence of the BBB was found present on one male flower bud displaying a typical larval boring hole and minor scouring chew marks on the foliage below. This minor evidence suggests a transient use of plants and therefore not an established BBB colony at this site.

The site is deemed as a potential BBB site, however its location surrounded by viticultural activities with the use of pesticides may have adverse effects (Fig. 35 & 36)..



Figure 35. Branson Road Reserve



Figure 36. Branson Road Reserve, mature Adriana plant.

Survey Results

The survey found existing BBB colonies persisting as highlighted in the BBB Action Plan and in similar population densities.

Population numbers were found to be directly linked with *Adriana* plant growth stages, health, and site densities.

BBB egg and larval presence was observed on both young and old male and female *Adriana* plants showing a distinct preference for the younger male plants with inflorescence.

The use of male flower spikes for egg laying and early larval stages is preferential with latter larval stages utilising older leaves for their completion of development. Where male flowers spikes were absent, egg laying, and larval development was initiated on leaf buds of both male and female *Adriana* plants.

Population numbers were found highest at sites where male *Adriana* inflorescences were present at various development stages and available for use for longer periods of time.

Both Parham and Port Gawler sites are the strong hold of the BBB colonies and continue to support the major *Adriana* populations along the northern coastline.

Webb Beach supports a smaller persistent colony, whether self-sustaining or transient based is unclear due to the proximity to Parham.

Natural *Adriana* regeneration in shell grit areas has been observed at Port Gawler complementing the older plants that were extremely stressed during 2016-2020.

These plants continue to grow well and were found in good health providing ideal larval host plants.

Torrens Island BBB population is deemed low in numbers, and this is attributed to the state of *Adriana* plants and habitat.

Biodiversity Park and Mutton Cove sites at present are used occasionally and opportunistically by the BBB.

At Minda Dunes the successive BBB population failure is attributed to the highly stressed *Adriana* plants during the summer period of 2022-2023.

Moana Sands CP and adjoining Graham Rabbett Reserve BBB population failure is also attributed to highly stressed *Adriana* plants during the summer period of 2022-2023.

Hackham Creek survey failed to find evidence of BBB, however localised environmental conditions may play a role with delayed BBB pupae emergence.

Coast to Vines Rail Trail site BBB translocation has been successful with continuous butterfly generations being observed. The good numbers of BBB adults and larvae observed during surveys is very encouraging with the site possibly becoming a donor population for translocation of southern BBB populations.

The BBB populations at Normanville Dunes is extinct due to *Adriana* plant death and Lady Bay sites are deemed low in numbers attributed to unsuitable *Adriana* plant population.

BBB Translocation Sites

The BBB Action Plan recommends increasing butterfly habitats and population numbers within Adelaide metropolitan region.

Adriana plantings continue to be undertaken within the metropolitan regions and many sites are yet to attain suitable plant growth for the species translocations.

Two of the three sites were assessed in December 2022 for potential BBB introductions; Hackham Creek at Noarlunga and Coast to Vines Rail Trail at McLaren Vale and found to be suitable.

Translocation of BBB to these two sites was undertaken in December 2022.

The third site, Branson Road Reserve at Tatachilla assessed as suitable was not subject to translocations during December 2022 due to its location and viticultural impacts. This decision is currently under review.

The nearest potential donor BBB populations at Torrens Island and Le Fevre Peninsula were surveyed and found unsuitable due to low population numbers. The two major BBB populations; Parham and Port Gawler were found suitable as donor sites with eggs and larvae being harvested.

Priority Actions

The key factors identified in strengthening BBB populations are *Adriana* plant health, distribution and density. Plantings continue to be undertaken in coastal metropolitan areas; however, the majority have been undertaken in areas deemed marginal and which may result in poor plant performances and consequently impact on future BBB outcomes. Further BBB reintroductions along the Metropolitan coast are dependent upon suitable *Adriana* stands and are considered a key priority.

The uses of both male and female *Adriana* plants in the revegetation works are important as the BBB displays at times some plant preference. There are many potential sites for establishment of *Adriana* away from the current coastal sites which include storm water drain systems, council parks, roadside vegetation strips, school, and residential gardens.

It is a priority that key future *Adriana* planting sites be identified and site plans formulated to create interconnectivity corridors for BBB along the coastal areas from Port Gawler to Aldinga Beach.

The strengthening of the southern coastal Normanville Dunes *Adriana* stands using plant material sourced from the Lady Bay site is most important.

The investigation of suitable areas within the Salisbury wetlands is recommended and a key priority.

Specific Site Recommendations

Parham	Undertake additional <i>Adriana</i> plantings in the areas south of the sporting complex. Increase <i>Adriana</i> stands away from the township where possible to minimise the risk of clearing, fires and damage especially in the northeast of the township. Undertake additional <i>Adriana</i> plantings in the newly acquired National Parks parcel of land (Appendix 3 – Parham Map).
Webb Beach	Rejuvenate a percentage of senescing plants and increase the number of <i>Adriana</i> plants in the general area as additional security for the meta population of Parham-Webb Beach.
Port Gawler	Develop an <i>Adriana</i> management plan for this site and rejuvenate senescing Adriana stands in areas not supporting natural regeneration.
Torrens Island	Undertake <i>Adriana</i> plantings on the Island away from the current sites to increase the overall number of plants and reduce the risk of BBB extinction due to fire risk and the uncertainty of AGL's future land use. Translocate larvae from main population site (when deemed suitable) to planted Adriana stands within AGL's landscape gardens.
Biodiversity Park	Continue with further <i>Adriana</i> plantings away from the current stands and proposed concept modelling of road works in suitable areas. Choose areas with soils able to retain water for longer periods.
Largs North Dunes	Continue with enhancing the number of plants at site.
Barker Inlet wetlands	Continue with enhancing the number of plants at site.
Normanville Dunes	Undertake <i>Adriana</i> plantings in less sandy areas or in heavier soils able to retain moisture for longer periods. Explore possibilities of <i>Adriana</i> plantings within precincts of Bungala River and the township.
Lady Bay	Rejuvenate senescing <i>Adriana</i> stands and/or enhance by further plantings. Continue with roadside revegetation plantings and other suitable areas where possible. Create interconnectivity corridors of <i>Adriana</i> stands to Normanville Dunes North using Lady Bay Site <i>Adriana</i> plant stock for all local

Appendices

Appendix 1.

A guide to successful growing of Adriana plants



Adriana quadripartita (Coastal Bitter-bush), in the family EUPHORBIACEAE is a hardy perennial plant tolerant of many harsh environmental conditions. Plants are dioecious having separate male and female plants being small to medium sized shrubs often quite compact in appearance.

The plant prefers growing in open sunny positions associated with well drained soils such as alkaline sands and calcrete soils containing a small percentage of clay matter and will grow in most well drained

soils when planted. It responds well to disturbed soils and is often the primary regenerative plant.

Adriana struggles to grow in coastal sands, especially primary and secondary dune systems and is marginally found in coastal sand swales where finer alkaline materials create a denser soil structure.

Soil hydrology plays an important role in the establishment and growth of the plant with well hydrated plants achieving greater establishment and faster growth results. These plants often display larger lushes green leaves and growth against stressed plants with narrowed leaves with a stalky appearance.

Preferred propagation is from cuttings and relatively easy striking roots in less than 6 weeks, thus allowing for specific selection of plant characteristics desired. *Adriana* plants are dioecious having separate male and female plants and this need to be taken into consideration when harvesting cuttings for revegetation works. Plant genetics diversity in revegetation programs is important and multiple donour plants should be used in cuttings selection, both male and female plants.

Adriana plants are quite hardy and drought tolerant, developing large branching root systems, they are reasonably shallow rooted and periodic availability of water is critical to their survival.

Adriana propagation requires correlation with field planting times allowing for the correct plant structure and development to be present when planted out. Plants, usually supplied in 50mm forestry tubes, need to be actively growing, meaning both

active shoot and root systems increasing the transplant survival rate. Plants produced in commercial nurseries enjoy the benefits of daily watering and regular fertilisation producing well looking fast growing plants, these however when transplanted are often found struggling if not dead. Whilst nurseries will harden their plants for sunlight, *Adriana* is a plant that also requires water hardening. This process further develops and hardens the root system encouraging active water and nutrient searching once transplanted.

It is also extremely important to balance the plant's shoot and root systems prior to planting out if necessary. Shoot systems, meaning above ground foliar growth, being more developed than the root systems will induce a water imbalance within the plant leading to plant stress and potential death. Ratios of 1/1 shoot to root system sizes are desired minimising this risk and are obtained by trimming access foliar growth to match.

Active plants displaying healthy shoot and root systems are to be planted with clean green compact foliar growth and active white root tips with plants displaying stretched or sickly growth and root bound yellowish root systems to be avoided.

When selecting planting sites, choose areas with soils characterises favouring Adriana plants. Look for natural depressions in sandy area sites, loamy sands, calcrete soils where available and areas subject to periodic water runoff such as sides of paths or walkways in urban settings.

Use solid reasonably transparent tree guards allowing greater light infiltration increasing photosynthesis and minimising transpiration during the establishment phase.



Female Adriana plant



Male Adriana plant



Tube stock



Root systems: left root bound, right healthy

Appendix 2. Landscape Uses

Adriana plants respond positively to trimming or slashing and senescing plants can be rejuvenated using these techniques with plant regrowth being fast and lushes.

The plant's ability to respond positively to trimming provides growing opportunities outside of the normal revegetation or habitat restoration works.

Creating *Adriana* hedges in garden landscapes or public spaces settings is another way of creating BBB habitats.



Adriana hedge in Garden landscape setting. Photo credit: Gary Belder

Appendix 3. Parham Map



Map - Current Adriana stands marked red, National Park areas outlined in green.

References

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