North Stirlings and Pallinup River Catchments

REVEGETATION GUIDE

NORTH STIRLINGS PALLINUP NATURAL RESOURCES

Restoring biodiversity values on farmland through direct seeding and seedling plantings

BY WENDY BRADSHAW AND GEOFF WOODALL

ACKNOWLEDGEMENTS

The concept of this revegetation guide was inspired by the format of the Simple Systems for Revegetation in the Bremer River Catchment booklet written by Nathan McQuoid and designed by Natasha Moore (2009) and is gratefully acknowledged.

This project is supported through funding from the Australian Government and South Coast Natural Resource Management.

North Stirlings Pallinup Natural Resources Inc. and the Gillamii Centre Inc. are acknowledged for supporting the project idea that enabled the funding in the first place.

Authors

WENDY BRADSHAW

B Land Management (Ecological Agriculture) U Sydney, M Education (Social Ecology) UWS.

GEOFF WOODALL

BSc. (Hort.) Hons., PhD (Queensland University)

Disclaimer

Australian Government

SOUTHCOAST NATURAL RESOURCE MANAGEMENT

NORTH STIRLINGS PALLINUP NATURAL RESOURCES

GILLAMII CENTRE Sustainable Agriculture In Practice

CONTENTS

INTRODUCTION

Resilient farm ecosystems are vital for sustainable productivity and therefore profitability. Resilient farm ecosystems are a product of high levels of biodiversity.

Biodiversity is an all-inclusive term that includes interactive processes between the physical environment and living things.

It is about life, death and decay at genetic, species and ecosystem levels and is not just what happens in nature reserves!

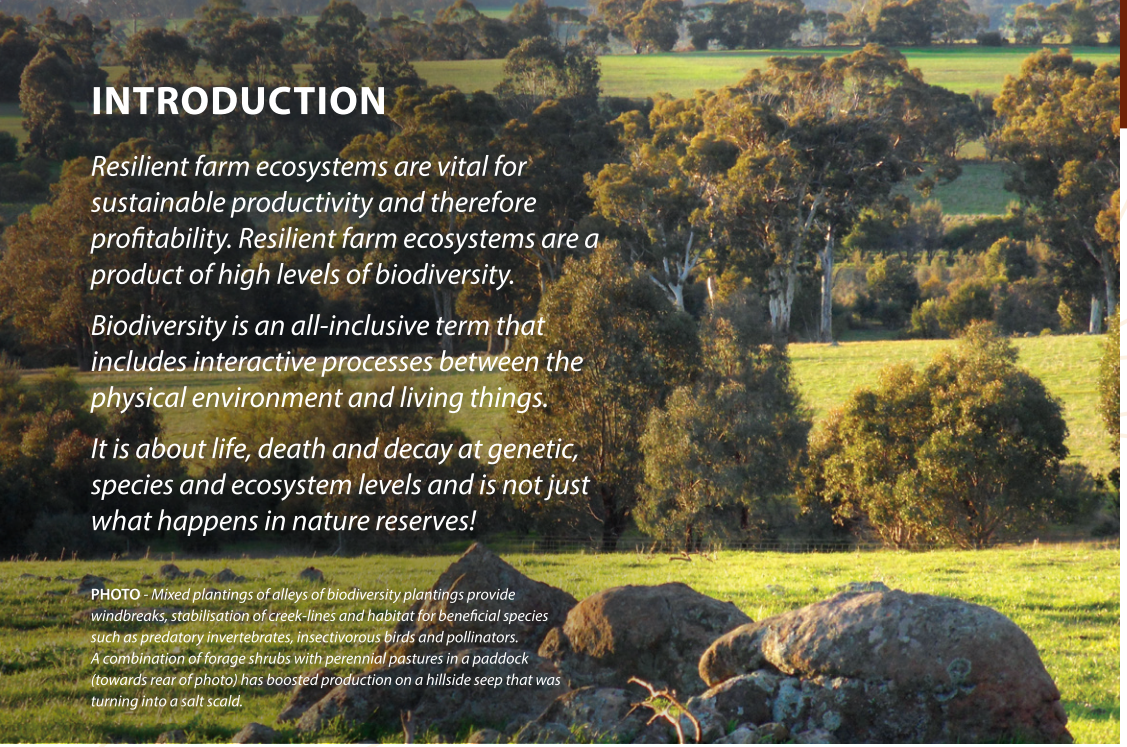


PHOTO - *Mixed plantings of alleys of biodiversity plantings provide windbreaks, stabilisation of creek-lines and habitat for beneficial species such as predatory invertebrates, insectivorous birds and pollinators. A combination of forage shrubs with perennial pastures in a paddock (towards rear of photo) has boosted production on a hillside seep that was turning into a salt scald.*

Biodiversity provides stability of ecosystem function and therefore resilience to farming landscapes. A diversity of woody and herbaceous perennial plants adds stability to landscapes dominated by annual crops and pastures. They provide habitat for beneficial fauna that together help maintain ecosystem services such as soil formation, provision of food and shelter, pollination, cycling of nutrients, pest management, hydrological balance, a lovely place to live and much more.

A 'backbone' of native vegetation provides habitat for wildlife and adds resilience to farm ecosystems. Some might say that it just adds more 'roos', rabbits and foxes. And this is certainly likely: these are issues that need to be managed. The bigger picture is the health of the farm ecosystem and the farmer's vision for how they would like it to be now and in the future.

Resilience supported by biodiversity enhances the farm's capacity to buffer the damaging effects of disturbance such as storms, droughts, frosts, floods and plagues. Successful revegetation produces self-sustaining systems that have all of the key structural and functional elements necessary for successional processes to occur effectively.

This guide aims to provide methods as well as species guides that include key structural and functional elements of native vegetation communities of the mid-upper Pallinup River and surrounds. Vegetation communities are linked to associated soil types and landscape positions.

The capacity of the restoration work to evolve over time is enhanced by being linked to existing bushland, which enables more flora and fauna species to move around the landscape. An effort has been made to include a range of key species listed in the vegetation communities that are currently able to be grown from seed and / or seedlings.

SEED *OR* SEEDLINGS?

The revegetation of poor quality agricultural land is achieved by the planting of nursery raised seedlings and / or sowing native seeds (direct seeding). The direct seeding of native plants is now a reliable establishment technique, provided there is adequate practitioner competence and access to appropriate equipment. Technological improvements in both seeding equipment and native plant agronomy have led to improved reliability and uniformity of direct seeding. Some species, for one reason or another, should still be planted as nursery raised seedlings / rooted cuttings (e.g. *Adenanthos* and *Lambertia* species).

The technique of direct seeding can readily establish plant densities of 1000-5000 plants per hectare, which is ideal for creating structurally complex vegetation. Direct seeding can be a cheap establishment technique (as low as $500 per hectare) but for most operators it has a higher risk of failure than the planting of nursery raised seedlings that are far more expensive to establish.

While robust systems and improved equipment have been developed, the main obstacle to reliable establishment is the fact that direct seeding of native seed requires a much higher level of competency than that required to plant a nursery raised seedling. The important factors that determine the success of a direct seeding operation are:

- *practitioner competency*
- *selecting the most appropriate sowing method, equipment and setup of equipment*
- *understanding species suitability to proposed site*
- *moisture management*
- *appropriate pest and weed control*
- *understanding site conditions (soils [pH, chemical history, and fertility], climate, land use history, pests and diseases, etc)*
- *timing*
- *germination characteristics and niche requirements of species*
- *sowing depth*
- *seeding rate and species mix*
- *seed quality*
- *seed preparation (breaking dormancy, inoculants)*

Practitioner Competency

People who are interested in the local flora are encouraged to develop skills in this plant establishment. It can take many years to develop reliable establishment skills and during this learning phase it is recommended that practitioners use direct seeding coupled with the planting of nursery raised seedlings to establish sites.

Often large numbers of species are involved, with highly variable seed size and shape, contrasting germination requirements and factors that can influence success or failure. For those people who are not interested in the local flora / revegetation it is recommended that appropriate people with expertise be used to provide technical assistance or contracting services.

PLANNING

Diverse understorey species will create better habitat than dense stands of trees that outcompete understorey. Prickly shrubs such as Hakea prostrata (left foreground) and Hakea corymbosa (round bush to left rear), as well as bushy shrubs such as one-sided bottlebrush Calothamnus quadrifidus (rear left and right understorey) provide habitat for small birds and beneficial predatory insects.

Planning for revegetation needs to be undertaken in context with the objectives of the landholder and whole-farm planning. A few examples of objectives might be to stabilise soil such as salt scalds or gutless sands, to create linkages with existing bushland and habitat for beneficial fauna such as insectivorous birds, bats and predatory insects and possibly for fauna that you wish to attract back to your property, to make the place look and feel great!

If targeting specific fauna such as small mammals, dense understorey will be needed. Stages of planning for revegetation include site assessment, organising resources to undertake the work, including seed and / or seedlings, machinery, funding and labour, and how to monitor achievement of objectives.

Where soil type and landscape position is suitable, revegetation that includes species such as banksias and hakeas can provide endangered species such as Carnaby's Cockatoo valuable additional food sources. Cockies are shown here feeding on Banksia mucronulata located on a gravel ridge west of Tambellup.

SITE ASSESSMENT

Information gathered at the site assessment informs revegetation design including site preparation, species selection and quantities of seed and / or seedlings, planting techniques and design, and threats to successful outcomes such as water-logging / salinity, rabbits, kangaroos and weeds. It is also a good time to consider necessary monitoring processes that track progress to achieve objectives and identify actions that need to be taken to address threats.

When visiting site, ensure boots and equipment are clean prior to entering and leaving site to prevent spread of disease such as dieback (*Phytophthora cinnamomi*). See page 13 for information on hygiene protocols.

It is useful to have an aerial photograph showing site and adjacent landscape features / habitats such as remnant vegetation, wetlands, and existing fencing; a pick or shovel to check out soil type; and a camera to take reference photos.

Before and after photos are valuable for monitoring change following revegetation activities.

COLLECT THE FOLLOWING INFORMATION FROM SITE AND DESKTOP ANALYSIS

- *Objectives of the planting, including expected timing of planting*
- *Location of site (with GPS coordinates to mark boundaries)*
- *Landform and associated rocks if visible (e.g. granite outcrop, riparian, sand plain)*
- *Soil type and colour of top-soil and sub-soil (sand/loamy, sand/clayey, sand/sandy, loam, loam/clay, loam/sandy, clay/loamy, clay/clay, with or without gravel), approximate depth of topsoil*
- *Map different soil types*
- *Condition of soil (e.g. compacted, % ground cover and type, evidence or threat of wind or water erosion) and hydrological features (e.g. water-logging, salinity, non-wetting)*
- *Vegetation type (ie. the tallest dominant species that is known to grow on that soil type and landscape position e.g. flat-topped yate (Eucalyptus occidentalis)*
- *Previous land use (e.g. grazing and fire history)*
- *Paddock fertiliser and herbicide history*
- *Are there factors that prevent the original vegetation being re-established (e.g. altered nutritional status, site now salt affected, altered soil pH)?*
- *List weeds observed and abundance*
- *An inventory of resources available for achieving objectives (e.g. identify matching vegetation type in bushland nearby that can be used as seed sources; machinery; labour; funding)*
- *Methods of weed and pest control, preparation and planting technique*
- *Once area to be revegetated is finalised, estimate the area to be revegetated to calculate quantities and cost of revegetation*
- *Take before photos from a spot(s) that can be easily replicated later as a minimum monitoring and evaluation tool*

SPECIES SELECTION



Sea rush Juncus kraussii thrives with upwelling of water in salt scald planted 1997 (left) showing recruitment 2012 (centre and right).

1 » Match the vegetation type identified in the site assessment process with the appropriate vegetation community listed at the end of this guide. It is emphasised that these lists are a starting point to guide the use of local species.

2 » Be sure to include the different layers of vegetation that occur with the target vegetation type e.g. Flat-topped yate woodland with bottlebrushes, paperbarks and rushes on winter waterlogging-prone soil.

3 » Include pioneer and coloniser species. Pioneer species are those that come up, often in large numbers after disturbance (such as fire), grow quickly, produce lots of seed and litter, and usually put nitrogen in the soil - and are often short-lived. That is, they set up the conditions for the long lived coloniser species that are slower growing and longer lived to establish. Examples of pioneer species are wattles (*Acacia* species), peas (eg. *Bossiaea*, *Kennedia*, *Senna*), native hibiscus (*Alyogyne*) and sheoak (*Allocasuarina*).

4 » Select a diverse mix of species in the lower, middle and upper storey to maximise habitat values (e.g. asynchronous flowering times, flower shapes and plant forms such as prickly, bushy, etc.) and resilience of the vegetation to be self-replacing over time (e.g. seeders and sprouters). Tree seedlings < 25% of overall planting with low, mid and tall shrubs, herbs, grasses and / or rushes making up the remainder. For information on seeding rates and mixes, see page 11.

5 » Seed collected from species in stands with large populations (more than 100-200 plants) will result in the highest quality revegetation sites. When this is not possible, seeds from smaller populations should be combined to ensure that newly restored populations have high genetic diversity. As a general rule, source seed from stands as close as possible to the revegetation site.

6 » Include spreading ground covers that protect the soil and trap water and nutrient runoff, thus reducing soil erosion, sedimentation and pollution of watercourses. Examples are rushes and sedges for creeklines / wet areas (e.g. *Juncus kraussii*, *Ficinia nodosa*, *Juncus pallidus*), low spreading shrubs and ground covers such as some *Acacia*, *Kennedia*, *Brachysemsa* species (now officially included with *Gastrolobium* genus but don't contain 1080), native pigfaces (*Carpobrotus* and *Disphyma*), and native grasses (e.g. wallaby grass, kangaroo grass, weeping rice grass and rush grass *Austrostipa juncifolia*).

SITE PREPARATION

1 » Retain old and large trees, dead or alive, as much as possible. They are important habitat for birds of prey which help control pests such as rabbits and mice, and bats to assist with insect pest management. Insectivorous bats eat up to twice their weight in insects every day.

Logs should also be retained because they provide homes for small mammals such as echidnas, as well as reptiles and invertebrates. If logs are obstructing planting routes, they can be pushed out of the way but not burnt.

2 » Waterlogged and / or salt affected should be mounded. If mounding in a separate pass to planting, mound in summer / early autumn to allow settlement and germination of weeds prior to planting.

Once mounded, don't allow stock onto mounded area or will damage the mounds. If grassy will need scarifying or scalping prior to mounding or will be cloddy and make poor mounds. Spray mounds after grasses have established on mounds, prior to planting.

3 » On rocky, difficult to access sites, a non-standard direct seeding approach might be required; seek technical assistance for these sites. Alternatively, deep ripping with a 3-point linkage ripper and spraying rip lines with appropriate herbicide might be the best option in preparation for planting seedlings with a pottiputki (hand-held tree planter).

Woody debris including hollow logs are important to keep as trap soil, litter and seeds and provide habitat; helping to crank up 'islands' of ecosystem function in degraded lands.

Mounding is needed on waterlogging-prone and saline soils. Contact NSPNR or the Gillamii Centre for availability of mounders.

Gen Harvey (Gillamii Centre) and Penni Hewett (South Coast NRM) planting seedlings into seeded soil using pottiputkis available from the North Stirlings Pallinup Natural Resources (NSPNR).

MACHINERY AND APPROACH

Broomehill farmer David Kinsey direct seeding with Chatfield Tree Planter with precision seeding attachment available from NSPNR.

Chatfield Tree Planter available from Gillamii Centre drops seed on soil surface. Heavy chain aiming to cover coarse seed and fine chain to cover fine seed.

CommVeg seeder enables optimal seed placement, which is critical on light sandy soils that are unable to retain moisture around the seed. For more information contact NSPNR.

A common tree planter that is fitted with a small seeds box can be used to direct sow native seeds (e.g. a Chatfield Tree Planter). Such equipment can be used to scalp 50mm of topsoil (to remove weed seeds), make a shallow rip (20-30cm deep), and scatter seed on the freshly disturbed soil.

It is advisable to drag a steel chain (or something similar) behind the machine to ensure shallow soil coverage over seed. This approach can be somewhat unreliable, deliver a non-uniform result and can be dramatically improved by modifying the machine so that the seed is placed in a stable soil environment at a precise depth.

Modified agricultural seeders can also be used to sow native plants, particularly native legumes (*Acacia* and *Kennedia*) and grasses. Proponents should however seek professional guidance as the sowing of natives is somewhat different to cereal crops and pastures.

While it might seem desirable to sow very quickly with a large modern air-seeder, the results are usually not as reliable as that achieved with machinery purpose built for native plants (modified tree planter or a purpose built native plant seeder such as a CommVeg seeder).

Agricultural machinery does a very poor job of sowing species such as many *Melaleuca* and *Eucalyptus* species. Higher seeding rates (double rates) should be used when seeding with standard agricultural machinery as this partially offsets lower seed use efficiency.

A local, purpose built, native plant seeder, the CommVeg seeder, is available. Contact your local NRM office to arrange hire. This machine can be used to scalp, rip and sow 1-3 lines per pass. On mounded wet sites it can be used to sow seeds on the top of tall mounds. Seedlings can either be planted by hand, with a pottiputki, or from the back of a Chatfield Tree Planter.

PLANTING DESIGN

Unless planting on fragile non-wetting sand, row spacings can be around 2.5m centres. Allow room to get over with a machine for follow up applications for control of insect pests or post-emergent weed control in the following year after planting. It is ideal to get as many rows in as possible and practical to maximize the cover of native vegetation.

On light fragile soils, 4m row centres are recommended and avoid aligning planting rows with the prevailing wind direction to minimise the risk of soil erosion. Do not scalp downslope on sandy soils. It is recommended to plant on the contour where possible in non-water-logged sites to enable water to be retained on site. Along waterways, where practical, mound at 45° to the direction of water flow to allow drainage of water to the watercourse and minimise the risk of erosion from flood events.

Plant spacings within rows will depend on methods used and budget available. If direct seeding and seedlings, it is expected that 5m seedling spacings would be adequate unless difficult conditions. Direct seeding is unsuitable for heavy clay soils and seedlings can be planted 1-2m apart. On salt scalds, direct seeding can be successful on mounds but it is a good idea to supplement with seedlings of species such as fiery bottlebrush (*Callistemon phoeniceus*) that can't cope with high salinity levels when germinating.

Established plant densities can be much higher when direct seeding than seedlings only. When all layers of vegetation are planted / seeded, it is not unrealistic to expect >4,000 stems/ha. To give a comparison with native bush regeneration 12 months post fire, over >40,000 stems/ha (including grasses) were recorded in a brown mallet *Eucalyptus astringens* woodland and >100,000 stems in a wandoo woodland east of Tambellup[5].

Planting across a slope provides windbreak as well as linking up two remnants at each end (left 2000, right 2006).

Native hibiscus Alyogyne huegelii is an example of a pioneer species that grows quickly, produces lots of seed, and is short-lived.

Ground cover running postman Kennedia prostrata (foreground) grow well from seed on gravelly soil.

WEED AND PEST CONTROL

Weed control should be targeted while weeds are actively growing and before flowering to prevent weed seed set. If the site is near a wetland or waterway, it is preferable to use Roundup Bioactive® instead of Roundup® that contains surfactants that are known to damage frog development and can lead to decline or even loss of such fauna species [1]. Alternately use a higher rate of glyphosate that doesn't contain surfactants; added spray-grade ammonium sulphate is suitable.

On previously cropped land and most pasture sites, an application of glyphosate 1-2lt/ha (450g/lt) with bifenithrin and 0.5-1.5kg/ha of Simazine® (900g/kg) applied to the site 3-4 weeks prior to establishment should deliver excellent control of pests and weeds. The scalping of the soil during seeding should remove residuals. On white-grey sandy sites do not use more than 0.5kg/ha of Simazine® (900g/kg).

There are no simple 'rules of thumb' for using herbicides and especially residual herbicides. Use of residual herbicides for weed control provides prolonged protection from weeds in the year of planting but needs to be considered in light of the following factors to prevent accidental plant deaths [2]:

- ***SOIL TYPE*** *- residuals such as Atrazine® and Simazine® are normally kept out of the root ball of seedlings because residuals bind with soil particles. However, they may not bind to coarse sands (e.g. river sand) and therefore may unexpectedly be found to leach into the root zone of the seedlings on these soils with adverse effects on plantings.*
- ***pH*** *- residuals such as Ally® break down quickly in acid soils but don't break down in alkaline soils. Ally® can be used if needed for certain weeds that glyphosate alone may not provide adequate control such as: dock, sorrel, clover, erodium (corkscrew), sour sob and four o'clock. It is applied before sowing seed or planting seedlings provided there has been 25-50 mm rainfall and at least two weeks have elapsed since spraying on acid soils only.*
- ***WHAT IS BEING PLANTED*** *- soluble residual herbicides are unsuitable for seed or seedling plantings unless targeted at species that aren't being planted such as grass selectives that can be used the year after planting such as Fuselade®, Verdict® (ie. when grasses haven't been planted!) and Taskforce® for African love grass.*
- ***METHOD OF PLANTING*** *- don't spray weeds prior to mounding as the chemical will be bound up and concentrated in the mounds and cause problems for seed or seedling survival. Spray after mounding but only seedlings can be planted if insoluble residual herbicides used unless scalping off topsoil to remove chemical from the root zone of germinants.*
- ***WHETHER PLANTING BY SEED AND / OR SEEDLINGS*** *- as a general rule, direct seeding can be carried out where insoluble residuals are used providing the top-soil is scalped off. Seedlings where insoluble residuals are used don't need to have the topsoil scalped provided mechanical methods of planting are used where the topsoil containing the chemical isn't squished in around the root ball.*
- ***RAINFALL*** *- in addition to the above points, the potential action of leaching of chemical into the root zone of establishing seed germinants / seedlings needs to be considered in context with the method of planting. For example, Simazine® is safe for most seedlings when planted on mounds but if on flat ground and seedlings are planted into a rip line, chemical can be washed into the rip line where it is concentrated and filters down to the root zone and kills off seed / seedlings.*

Good references for herbicide information include **Herbiguide** available online at ***herbiguide.com.au*** or **Southern Weed and Their Control** by John Moore and Judy Wheeler (2005), available from Department of Agriculture and Food WA (DAFWA).

Rabbits and excessive kangaroo numbers need to be managed prior to, during and after planting to ensure the survival of the planting. Where rabbits are a big problem on deep sands, fencing with rabbit netting might also be needed to achieve successful establishment. A number of Farmnotes on rabbit baiting are available from the DAFWA [4]. Assistance may also be available through the Red Card for Rabbits & Foxes program which may be accessed by contacting your local Landcare Office or South Coast NRM.

Most of the insect pests that cause damage to newly emerged crop and pasture plants also damage native plants, particularly at the cotyledon to six leaf stage. Preventative applications of insecticide are strongly recommended when direct seeding is used.

For example *Acacia*, *Atriplex*, and some eucalypts are extensively damaged by red-legged earth mite (RLEM). Many *Melaleuca* species (eg *M. hamata*) are not damaged by RLEM. Beetle larvae, Rutherglen bugs, weevils can all cause extensive damage to native plants before and after emergence and through to the several leaf stage. Locusts, wingless grasshoppers, beetles, weevils and Rutherglen bugs cause damage after germination, during the following spring-summer.

Seedlings of all species become resistant to RLEM damage once they have reached the 6 leaf stage and thus nursery raised seedlings are not normally damaged by RLEM. Controlling RLEM is usually not required for seedling only projects.

Adding insecticides into the weed control spray mix delivers good results. Adding, for example, bifenithrin and glyphosate together to control insects and weeds 21-28 days prior to sowing is highly effective. A follow up application of insecticide is usually required 2-10 weeks after sowing, depending on the results of the initial insect control.

Spiney rush Juncus acutus shown in this photo is a nasty weed easily distinguished with stiff needle-sharp tips and fan-shaped foliage is easily removed while in low numbers by digging out. Rapidly regenerates and completely covers an area, eliminating all other species and becoming impenetrable to humans and stock [3]. Grows on wet areas including saline sites.

Good weed control prior to direct seeding and seedling plantings is preferable to relying on post-emergent selective weed control strategies, and provides the opportunity for bare-earth residual insecticide application to protect direct seeding germinants from red-legged earth mite predation.

SEED RATES AND MIXES

A seeding rate of about 0.5 kg per hectare for experienced practitioners is recommended; on difficult soils or for practitioners with little experience at a rate of 700-800g is recommended. In many cases (but not all), biodiversity mixes contain approximately 200-300g/ha of leguminous species, 200-300g of myrtaceous species and the remaining is made up of other species.

General rule of thumb for the seeding rates for trees (e.g. yate, flooded gum, jarrah, marri) is <150g/ha, mallees and melaleucas also <150g/ha, and rock sheoak (*Allocasuarina huegelliana*), that has very high seed use of efficiency, at <5g/ha.

Seed is normally mixed with bulking agents (e.g. fine spongelite, fine vermiculite). These additives increase the total volume of material to be sown and improve the metering (spread) of seed over a site and also assist the movement of seed through the cogs of a seedbox. Usually seed is mixed with bulking agent to form a final volume of 1-3 litres/km of row to be sown.

Seeding with a precision seeder designed by Geoff Woodall (CommVeg seeder). Good weed control, precision sowing, and a stable soil environment are key to successful direct seeding.

Fertiliser can be added to this mix but it is desirable to keep and sow fertiliser separately. Approximately 1-10kg of fertiliser can be sown or spread with the seed. It is important to use a low or no phosphorous fertiliser when proteaceous species (e.g. banksias and hakeas) are sown.

The seeder must be calibrated to deliver the desired amount of seed / bulking agent mix. Aim for 100-200ml of mix/100m of sowing line. To calibrate, simply take off one seed tube from the seed distributor, tie on a plastic bag, travel 100-200m with the drive wheel engaged, take off the bag and measure the volume of the mix in the bag. Use this information to determine sowing rate (litres of mix per km and per ha) and thus total volume of mix required to sow the site.

Seed Treatments

All legumes (eg *Acacia* and *Kennedia*) are hard-seeded and the seed must be scarified before sowing. The author (Geoff Woodall) routinely uses two 10 second immersions into boiling water (with an immersion in room temperature water between hot water immersion) with consistently good results.

It is very important that each kilogram of seed is placed in an excess (usually five times the volume) of boiling water, that heat is removed via a rinse in cool tap water and that the seed is then dried to its pre-scarification moisture content or bulked up and sown immediately. Mechanical scarification is also suitable though under and over scarification can be a problem.

For many Australian species treating the seed with smoke stimulates germination (breaks dormancy) and can improve seedling vigor. Smoke also has some desirable fungicidal properties.
Many Australian species do not require any seed treatment (e.g. *Hakea laurina*, *Hakea nitida*), however to ensure they do not block the seed box it is recommended that the wings of seeds be removed (rubbed off) prior to sowing.

Timing

Optimum time of seeding differs according to climate - earlier in the more arid climates (e.g. mid-upper catchments) and later in wetter areas (e.g. lower Pallinup). Within a region, optimum time of sowing can vary with soil type (dry soils sown earlier, moist sites sown later). Time of sowing is also species dependent. Typically dry sites are sown late April-May and wet sites, late winter (late July).

Sowing Depth

Aim to sow most fine seeded species at a depth of 2-5mm; in soil prone to drying out (e.g. sand) or when dry seasonal conditions prevail increase the sowing depth by another 2-5mm or so.
Sow larger seeds deeper at 10-20mm; in soil prone to drying out or when dry seasonal conditions prevail, increase the sowing depth by another 10mm or so.

Some large seeds (e.g. *Banksia*) do not germinate well at depth, and thus when legumes, larger seeded eucalypts and banksias are combined in a mix a sowing depth of 10-15mm is recommended. When sowing a simple legume mix (e.g. *Kennedia* species and *Acacia saligna* for forage) on light textured soils, sow seeds at a depth of 20-30mm.

An ideal scalp created by the CommVeg seeder. 5-7cm of soil being removed from the centre of each scalp, grading to 0cm on the outer sides of each scalp line.

Soil preparation achieved with the CommVeg seeder. The machine was travelling from left to right and the image shows the view behind the scalper, showing clean dirt being ripped (spring tyne), small tillage disks and the first wheel of the floating seeder arm which places the seed and presses the seed sowing trench.

DIEBACK AND HYGIENE ISSUES

Farms are often free of dieback because they don't have public access and can be a stronghold for spectacular species such as this bull banksia Banksia grandis provided care is taken not to introduce the dieback pathogen.

Approximately forty percent of native plants of south Western Australia are susceptible to dieback (*Phytophthora cinnamomi*). Dieback infestation is chronic on the South Coast (from Walpole to Esperance) where very few large patches of un-infested bush remain. It is therefore critical to the health of the bushland and associated fauna to keep dieback-free status where this still exists.

Landowners with dieback-free bush on private property have the greatest ability to protect these areas by controlling access and following hygiene protocols to prevent infection[6].

Dieback is easily introduced with contaminated soil and spreads in the soil by water. Hence lower-landscape areas are most susceptible. Infection is most common in areas with rainfall >400mm but wet areas of the landscape in more arid areas are still capable of hosting the dieback fungus.

Strategies to minimise spread of dieback when undertaking revegetation:

- *Avoid revegetation in bushland that is able to regenerate naturally (e.g. isn't inundated with annual grasses) - eliminates the risk of introducing dieback through contaminated seedlings.*
- *Consider direct seeding rather than planting seedlings where practical.*
- *Purchase plants from nurseries with Nursery Industry Accreditation Scheme Australia (NIASA) accreditation.*
- *Complete planting when soil is moist, but not wet.*
- *If moving from one area of the bushland to another, ensure that all equipment and shoes are free of mud and soil. Brush soil from footwear and equipment and spray with solution (70% methylated spirits to 30% water) to disinfect between sites. Work from high points to low points in each paddock.*
- *Do not use mulch, or only use mulch that has been well composted (the heating process kills Phytophthora cinnamomi)[7].*

More information about dieback can be found online at ***dieback.org.au***

Vegetation communities in the Pallinup Catchment

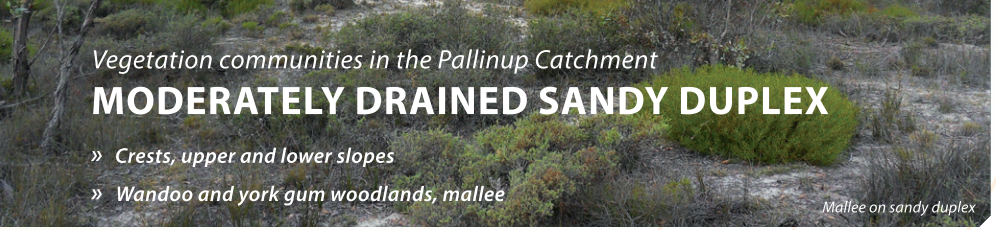
RED SOILS OFTEN WITH GRAVEL & DYKES

» *Upper to lower slopes* » *York gum, salmon gum & red morrell woodlands*

Salmon & york gum

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
Acacia acuminata	jam	
Allocasuarina huegelliana	rock sheoak	
Eucalyptus phenax ssp. phenax	white mallee, woodland mallee	sand, brown sandy loam, ironstone, granite
Eucalyptus flocktoniae / ssp. flocktoniae	merrit tree / mallee	
Eucalyptus longicornis	red morrell	
Eucalyptus loxophleba ssp. loxophleba	york gum	
Eucalyptus salmonophloia	salmon gum	
Hakea preissii	needle tree	
MID STOREY		
Acacia saligna	orange wattle	
Choretrum glomeratum	common sour bush	
Daviesia gracilis		
Hakea ruscifolia	candle hakea	
Rhagodia preissii ssp. preissii		
Senna artemisioides		
LOWER STOREY		
Acacia bidentata		
Acacia consobrina		
Acacia glaucoptera (prostrate form)	clay wattle	
Acacia lasiocarpa ssp sedifolia		
Acacia sclerophylla		
Acacia tetanophylla		
Atriplex semibaccata	creeping saltbush	
Austrostipa elegantissima	elelgant spear grass	
Brachysema celsianum	Swan River pea	along watercourses, flats, wet depressions
Carpobrotus modestus	inland pigface	
Dianella brevicaulis		
Disphyma crassifolium	round-leaved pigface	
Eutaxia microphylla		
Grevillea pectinata	comb-leaved grevillea	sandy or clayey soils over laterite
Kennedia coccinea ssp. coccinea		
Maireana brevifolia	small-leaf bluebush	
Neurachne alopecuroidea	fox-tail mulga	
Patersonia occidentalis	purple flag	
Rytidosperma caespitosum	wallaby grass	
Sclerolaena diacantha	grey copper burr	
Templetonia sulcata	centipede bush	

Note - Dominant species shown in bold



Vegetation communities in the Pallinup Catchment

MODERATELY DRAINED SANDY DUPLEX

» *Crests, upper and lower slopes*

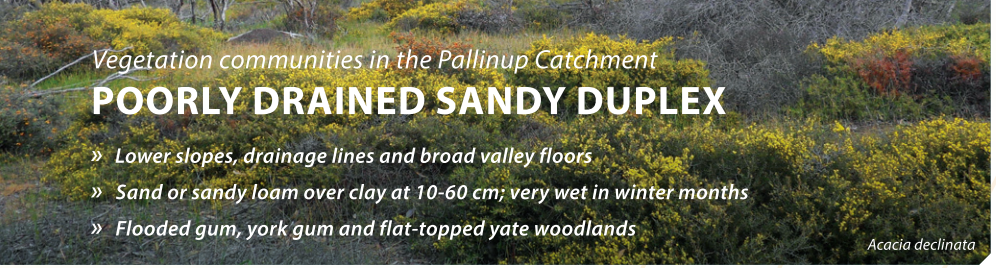
» *Wandoo and york gum woodlands, mallee*

Mallee on sandy duplex

York gum

Note *- Dominant species shown in* ***bold***

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
Acacia acuminata	jam wattle	
Acacia microbotrya	manna wattle	
Allocasuarina huegeliana	rock sheoak	
Allocasuarina lehmanniana	dune sheoak	
Eucalyptus celastroides ssp. virella		
Eucalyptus flocktoniae ssp. flocktoniae	merrit mallee	
Eucalyptus incrassata	ridge-fruited mallee	
Eucalyptus loxophleba ssp. loxophleba	york gum	
Eucalyptus phaenophylla		
Eucalyptus phenax		
Eucalyptus platypus ssp. platypus	moort	
Eucalyptus latens	narrow-leaved red mallee	
Eucalyptus sporadica	Kangaroo Island mallee	
Eucalyptus thamnoides ssp. megista	brown mallee	
Eucalyptus uncinata	hook-leaf mallee	
Eucalyptus vegrandis ssp. recondita		
Eucalyptus wandoo ssp. wandoo	wandoo/white gum	
Exocarpos sparteus	native cherry	
Hakea laurina	pincushion hakea	
Hakea preissii	needle hakea	
Santalum acuminatum	quandong	
MID STOREY		
Acacia brachyclada		
Acacia harveyi		
Acacia saligna	orange wattle	
Acacia sphacelata ssp. recurva		
Banksia media	southern plains banksia	
Banksia caleyi	Cayley's banksia	
Banksia sessilis	parrot bush	
Billardiera fusiformis	bluebells	
Calothamnus quadrifidus	one-sided bottlebrush	
Dodonaea viscosa ssp. angustissima	sticky hopbush	
Dodonea pinifolia		
Hakea corymbosa	cauliflower hakea	
Hakea trifurcata	two-leaf hakea	
Hypocalymma angustifolium	honey myrtle	sandier soils
Leptospermum erubescens	tea tree	sandier soils
Melaleuca adnata		on heavier soils
Melaleuca hamata	broom bush	on heavier soils
Melaleuca pentagona		on sandy/gravelly soils
Melaleuca spathulata		
Hakea prostrata	harsh hakea	
Hakea trifurcata	two-leaf hakea	
Rhagodia preissii ssp. preissii		
LOWER STOREY		
Acacia chrysocephela		
Acacia consobrina		
Acacia declinata	Pallinup gold	
Acacia lasiocarpa ssp sedifolia		
Acacia leptospermoides ssp. leptospermoides		
Acacia pulchella	prickly moses	lower slopes
Acacia sulcata ssp. platyphylla		
Astartea ambigua	check at herbarium	
Austrostipa elegantissima	elegant spear grass	
Brachysema celsianum	Swan River pea	along watercourses, flats, wet depressions
Carpobrotus modestus	inland pigface	
Dianella brevicaulis		
Grevillea oligantha		
Grevillea pectinata	comb-leaved grevillea	
Hakea corymbosa	cauliflower hakea	
Hakea lissocarpha	honey bush	
Hakea marginata		
Melaleuca carrii		
Melaleuca subtrigona		
Patersonia occidentalis	purple flag	

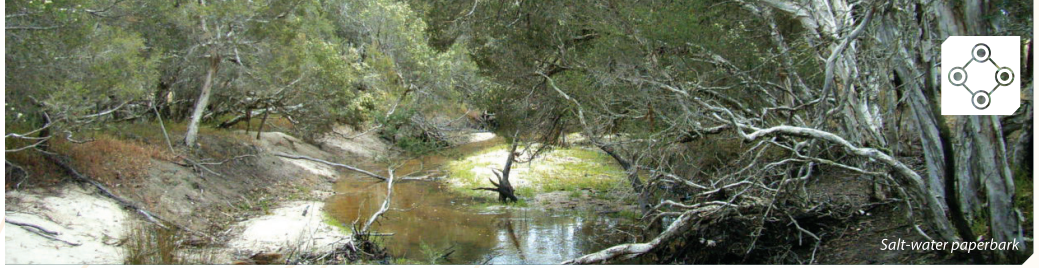


Vegetation communities in the Pallinup Catchment

POORLY DRAINED SANDY DUPLEX

- *Lower slopes, drainage lines and broad valley floors*
- *Sand or sandy loam over clay at 10-60 cm; very wet in winter months*
- *Flooded gum, york gum and flat-topped yate woodlands*

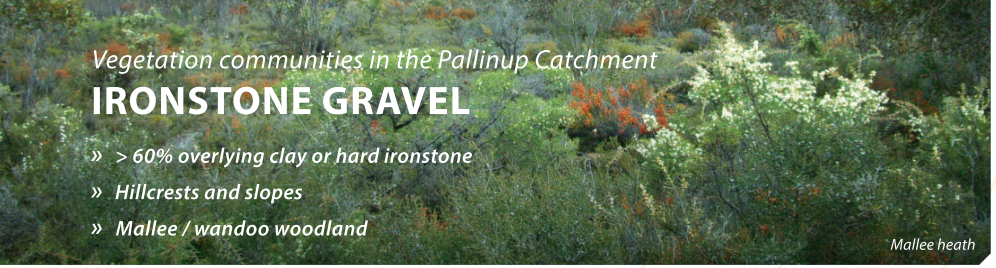
Acacia declinata



Salt-water paperbark

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
Acacia acuminata	jam wattle	
Acacia microbotrya	manna wattle	
Allocasuarina huegeliana	rock sheoak	
Casuarina obesa	swamp sheoak	in wetter areas
Eucalyptus decipiens ssp chalara	moit	on sandier soils
Eucalyptus loxophleba	york gum	
Eucalyptus occidentalis	flat-topped yate	
Eucalyptus phenax ssp. phenax	white mallee, woodland mallee	
Eucalyptus rudis	flooded gum	
Eucalyptus vegrandis/ ssp. recondita	clay mallee	
Eucalyptus spathulata	swamp mallet	
Melaleuca rhaphiophylla	swamp paperbark	
Hakea laurina	pincusion hakea	
Melaleuca cuticularis	salt-water paperbark	
Melaleuca strobophylla		
MID STOREY		
Acacia brachyclada		
Acacia cupularis		
Acacia cyclops		
Acacia sphacelata ssp recurva		
Alyogyne huegelii	lilac hibiscus	
Banksia media	southern plains banksia	
Callistemon phoeniceus	fiery bottlebrush	
Callitris pyramidalis	swamp cypress	
Exocarpos sparteus	native cherry	
Hakea corymbosa	cauliflower hakea	
Jacksonia sternbergiana	stink wood	
Labichea lanceolata	tall labichea	
Maireana brevifolia	small-leaf bluebush	
Melaleuca acuminata		
Melaleuca adnata		
Melaleuca bracteosa		
Melaleuca hamata	broom bush	
Melaleuca hamulosa		
Melaleuca spathulata		
Melaleuca viminea		
Meleleuca depauperata		
Regelia inops		sandier soils
Rhagodia preissii ssp. preissii		
Templetonia retusa	cockies tongues	
LOWER STOREY		
Acacia consobrina		
Acacia declinata		
Acacia glaucoptera	clay wattle	
Acacia pulchella var. goadbyi		
Acacia redolens (prostrate form)	vanilla wattle	
Astartea fascicularis		
Atriplex semibaccata	creeping salt bush	
Austrostipa elegantissima	elegant spear grass	
Austrostipa juncifolia		
Brachysema celsianum		
Carpobrotus modestus	inland pigface	
Dianella brevicaulis		
Disphyma crassifolia	round-leaved pigface	
Enchylaena tomentosa ssp tomentosa	ruby saltbush	
Ficinia nodosa	knotted club rush	on sandier wetter sites
Hakea marginata		
Juncus kraussii	sea rush	wet conditions
Juncus pallidus	pale rush	
Kennedia coccinea ssp. coccinea		
Patersonia occidentalis	purple flag	
Sporobolus virginicus	marine couch	

Note - Dominant species shown in ***bold***



Vegetation communities in the Pallinup Catchment

IRONSTONE GRAVEL

- *> 60% overlying clay or hard ironstone*
- *Hillcrests and slopes*
- *Mallee / wandoo woodland*

Mallee heath

Wandoo

Note **- Dominant species shown in *bold***

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
Acacia acuminata	jam	
Allocasuarina huegelliana	rock sheoak	
Banksia grandis	bull banksia	
Eucalyptus astringens ssp. astringens	brown mallet	
Eucalyptus decipiens	moit	
Eucalyptus dorrienii	silver mallee	
Eucalyptus incrassata	ridge-fruited mallee	
Eucalyptus phenax	Kangaroo Island mallee	
Eucalyptus pluricaulis ssp. pluricaulis		
Eucalyptus pluricaulis ssp. porphyrea	purple-leaved mallee	
Eucalyptus sporadica		
Eucalyptus wandoo ssp. wandoo	wandoo	
Eucalyptus xanthonema ssp. xanthonema		
MID STOREY		
Anigozanthos humilis	cat's paw	
Banksia caleyi	Cayley's banksia	
Banksia sessilis/var sessilis	parrot bush	
Banksia sphaerocarpa	round-fruit banksia	
Billardiera fusiformis	bluebells	
Calaothamnus quadrifidus	one-sided bottlebrush	
Hakea prostrata	harsh hakea	
Hakea ruscifolia	candle hakea	
Hakea trifurcata	two-leaf hakea	
Hakea undulata	wavy-leaved hakea	
Hakea varia		
Jacksonia furcellata		
Jacksonia sternbergiana	stinkwood	
Melaleuca pentagona		
Melaleuca pungens		
Melaleuca spathulata		low ridges
Allocasuarina thuyoides	horned sheoak	

BOTANICAL NAME	COMMON NAME	NOTES
LOWER STOREY		
Acacia browniana ssp. intermedia		
Acacia chrysocephala		
Acacia lasiocarpa var sedifolia		
Acacia pulchella ssp. pulchella	prickly moses	
Acacia stenoptera	narrow winged wattle	
Astroloma compactum		
Astroloma pallidum	kick bush	
Babingtonia camphorosmae	camphor myrtle	
Billardiera variifolia		
Bossiaea eriocarpa	common brown pea	
Calothamnus sanguineus	silky-leaved blood flower	
Daviesia preissii		
Hakea lehmanniana	blue hakea	
Hakea lissocarpha	honey bush	
Hypocalymma angustifolium	honey myrtle	sandy gravel
Kennedia coccinea	coral vine	
Kennedia prostrata	running postman	
Kunzea preissiana		
Melaleuca carrii		
Melaleuca subtrigona		
Melaleuca violacea		low ridges
Neurachne alopecuroidea	fox-tail mulga	
Patersonia occidentalis	purple flag	
Rytidosperma caespitosum / setaceum / acerosum	wallaby grass	
Stylidium repens		
Tetraria octandra		
Trachymene pilosa		

Vegetation communities in the Pallinup Catchment

MALLET HILLS

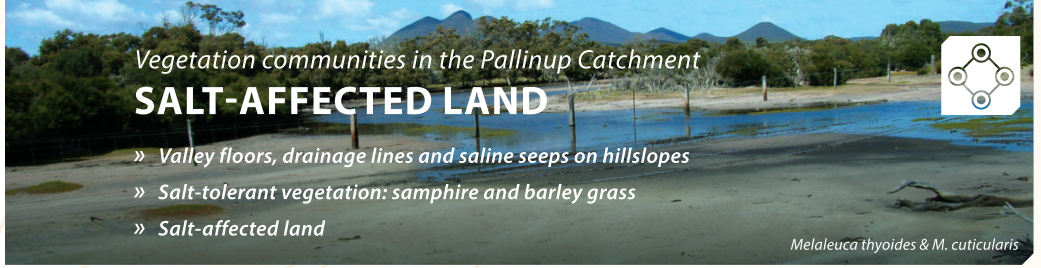
- *Breakaways or upper slopes and ridges on pink or reddish water repellent soils*
- *May be gravelly, often acidic*
- *Blue and brown mallet*

Breakaway

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
Acacia acuminata	jam	
Alocasuarina huegeliana	rock sheoak	
Eucalyptus astringens ssp. astringens	brown mallet	north-western areas
Eucalyptus astringens ssp. redacta	coastal brown mallet	east to south eastern areas
Eucalyptus gardneri	blue mallet	
Eucalyptus pluricaulis ssp. porphyrea	purple leaved mallee	
Eucalyptus thamnoides	brown mallee	
MID STOREY		
Acacia saligna	orange wattle	
Alyogyne huegelii	native hibsicus	
Daviesia gracilis		
Goodia medicaginea*	clover-leaf poison	
Rhagodia preissii ssp. preissii		
LOWER STOREY		
Acacia glaucoptera (prostrate form)	clay wattle	
Atriplex semibaccata		
Austrostipa variabilis	native speargrass	
Austrostipa elegantissima	elegant spear grass	
Banksia armata	prickly dryandra	
Carpobrotus modestus	inland pigface	
Eutaxia microphylla var. microphylla		
Kennedia coccinea ssp. coccinea		
Neurachne alopecuoidea	fox tail mulga	
Rytidosperma caespitosum	wallaby grass	
Templetonia sulcata	centipede push	

** maybe toxic to stock*

Note** - Dominant species shown in **bold



Vegetation communities in the Pallinup Catchment

SALT-AFFECTED LAND

- *Valley floors, drainage lines and saline seeps on hillslopes*
- *Salt-tolerant vegetation: samphire and barley grass*
- *Salt-affected land*

Melaleuca thyoides & M. cuticularis

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
Casuarina obesa	swamp sheoak	sand, clay
Eucalyptus occidentalis	flat-topped yate	on barley grass
Eucalyptus othostemon		
Eucalyptus spathulata	swamp mallet	
Melaleuca cuticularis	salt-water paperbark	high salt tolerance
Melaleuca strobophylla		clay, sandy silt
MID STOREY		
Acacia patagiata		white-grey sand, sandy loam, clay
Callistemon phoeniceus	fiery bottlebrush	range of soil types
Callitris pyramidalis	swamp cypress	shallow duplex
Melaleuca hamulosa		
Melaleuca lateriflora		
Melaleuca ordinifolia		
Melaleuca thyoides		
Melaleuca viminea		
Melaleuca brophyi		clay
LOWER STOREY		
Acacia redolens	vanilla wattle	saline or alkaline clay, loam, sand
Atriplex semibaccata	creeping saltbush	clay, sand, loam, laterite
Austrostipa juncifolia	rush-leaved grass	
Disphyma crassifolium	round-leaved pigface	sand, loam, clay
Enchylaena tomentosa ssp tomentosa	ruby saltbush	
Ficinia nodosa	knotted club rush	sand, sandy clay, granite, limestone
Juncus kraussii	sea rush	white or grey sand, clay
Juncus pallidus	pale rush	
Maireana brevifolia	small-leaf bluebush	loam, sandy clay
Sporobolus virginicus	marine couch	seedling only
Verticordia plumosa		on barley grass

Note** - Dominant species shown in **bold

Vegetation communities in the Pallinup Catchment

UNDULATING SANDPLAINS

» *Pale grey or white sand deeper than 80 cm*

» *Mallee over heath*

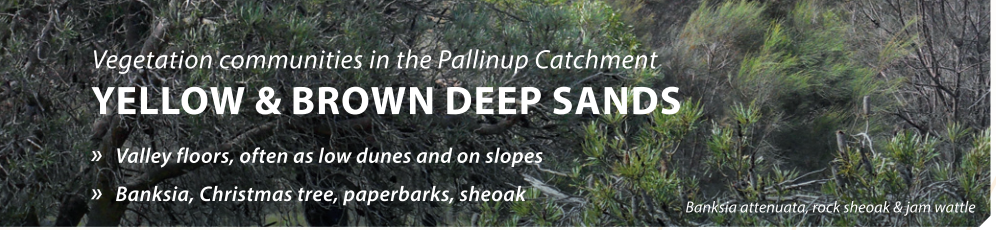
Banksia attenuata, leptospermum erubescens

Banksia attenuata & Calothamnus gracilis

*Note - Dominant species shown in **bold***

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
Banksia attenuata	slender banksia	
Eucalyptus angulosa	ridge-fruited mallee	
Eucalyptus decipiens ssp chalara	moit	
Eucalyptus incrassata	lerp mallee	
Eucalyptus pachyloma	Kalgan plains mallee	
Eucalyptus phaenophylla		
Eucalyptus platypus / ssp. platypus	moort	
Eucalyptus pleurocarpa	tallerack	
Eucalyptus sporadica		
Eucalyptus vegrandis		
Eucalyptus uncinata	hook-leaf mallee	
Acacia microbotrya	manna wattle	
Hakea laurina	pincussion hakea	
Lambertia inermis ssp. inermis	chittick	
Nuytsia floribunda	WA Christmas tree	plant seed near host second year after planting
Santalum acuminatum	quangdong	
MID STOREY		
Acacia brachyclada		
Acacia cupularis		
Acacia cyclops	coastal wattle	
Acacia saligna	orange wattle	
Acacia sphacelata ssp. recurva		
Acacia subcaerulea		
Allocasuarina humilis		
Allocasuarina lehmanniana	dune sheoak	
Banksia caleyi		
Banksia media	southern plains banksia	
Banksia sessilis	parrot bush	
Billardiera fusiformis	bluebells	
Calothamnus gracilis		
Eremea pauciflora		

BOTANICAL NAME	COMMON NAME	NOTES
Hakea nitida	frog hakea	
Hakea ruscifolia	harsh hakea	
Hypocalymna angustifolium	honey myrtle	
Jacksonia furcellata		
Leptospermum erubescens	teatree	
Leptospermum oligandrum		
Regelia inops		
Melaleuca hamata	broom bush	
LOWER STOREY		
Acacia cochlearis	rigid wattle	
Acacia pulchella ssp goadbyi		
Banksia pteridifolia	tangled honeypot	
Banksia repens		
Carpobrotus modestus	inland pigface	
Choretrum glomeratum	common sour bush	
Daviesia preissii		
Dianella brevicaulis		
Kunzea preissiana		
Melaleuca carrii		
Melaleuca subtrigona		
Chloris truncata	windmill grass	



Vegetation communities in the Pallinup Catchment

YELLOW & BROWN DEEP SANDS

» *Valley floors, often as low dunes and on slopes*

» *Banksia, Christmas tree, paperbarks, sheoak*

Banksia attenuata, rock sheoak & jam wattle

Banksia attenuata with flat-topped yate

*Note - Dominant species shown in **bold***

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
Acacia acuminata	jam	
Allocasuarina huegeliana	rock sheoak	
Banksia attenuata	slender banksia	
Corymbia calophylla	marri	north west of the Stirling Ranges only
Eucalyptus dorrienii	silver mallee	
Eucalyptus latens	narrow-leaved red mallee	
Eucalyptus occidentalis	flat-topped yate	
Eucalyptus phaenophylla		
Eucalyptus phenax ssp. phenax		
Eucalyptus rudis	flooded gum	on perched water table/ valley floors
Eucalyptus vegrandis		
Eucalyptus uncinata	hook-leaf mallee	
Hakea laurina	pincushion hakea	
Melaleuca cuticularis	salt-water paperbark	wet areas
Nuytsia floribunda	WA Christmas tree	plant seed near host 2nd year after planting
Santalum acuminatum	quangdong	
MID STOREY		
Acacia brachyclada		
Acacia cyclops		
Acacia harveyi		
Acacia saligna		
Acacia sphacelata ssp. recurva		
Acacia triptycha		
Allocasuarina humilis	dwarf sheoak	
Allocasuarina lehmanniana	dune sheoak	
Banksia media		
Callistemon phoeniceus		valley floors
Choretrum glomeratum	common sour bush	
Exocarpos sparteus	broom ballart	
Hakea corymbosa	cauliflower hakea	
Hakea ruscifolia	candle hakea	
Jacksonia furcellata		
Leptospermum erubescens	kerosene bush/roadside teatree	
Melaleuca brevifolia		valley floors
Melaleuca cucculata		low landscape
Melaleuca viminea		valley floors
Viminaria juncea	swish bush	valley floors
LOWER STOREY		
Acacia laricina var. laricina		
Astartea fascicularis		
Banksia repens	creeping banksia	
Calytrix leschenaultii		
Carpobrotus modestus	inland pigface	
Ficinia nodosa	knotted club rush	valley floors
Hakea lissocarpha	honey bush	
Kennedia prostrata	running postman	
Melaleuca carrii		
Patersonia occidentalis	purple flag	
Thomasia angustifolia	narrow-leaved thomasia	

Vegetation communities in the Pallinup Catchment

ROCKY OUTCROPS

» *Granite, dolerite, quartz & hard ironstone* » *Wandoo, york gum, mallee*

Silver mallee

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
Acacia acuminata	jam	
Acacia lasiocalyx	silver wattle	
Allocasuarina huegeliana	rock sheoak	
Eucalyptus falcata	silver mallee	
Eucalyptus incrassata	lerp mallee	
Eucalyptus loxophleba ssp. loxophleba	york gum	
Eucalyptus phenax	Kangaroo Island mallee	
Eucalyptus platypus	moort	
Eucalyptus sporadica		
Eucalyptus thamnoides ssp. megista	brown mallee	
Eucalyptus vegrandis ssp. recondita	clay mallee	
Eucalyptus wandoo ssp. wandoo	wandoo	
Euclayptus phaenophylla		
MID STOREY		
Acacia saligna	orange wattle	
*Goodia medicaginea**	clover-leaf poison	
Allocasuarina lehmanniana	dune sheoak	
Billardiera fusiformis	bluebells	
Calothamnus quadrifidus	one-sided bottlebrush	
Choretrum glomeratum	common sour bush	
Exocarpos sparteus	broom ballart	
Hakea prostrata	harsh hakea	
Melaleuca elliptica	granite honey myrtle	
Melaleuca hamata	broom bush	
Rhagodia preissii ssp. preissii		
LOWER STOREY		
Acacia browniana / ssp. intermedia		
Acacia lasiocarpa var sedifolia		
Austrostipa variabilis	native speargrass	
Brachysema celsianum	Swan River pea	
Hakea marginata		winter-wet areas
Kennedia coccinea ssp. coccinea		
Neurachne alopecuroidea	fox tail mulga	
Patersonia occidentalis	purple flag	
Rytidosperma caespitosum	wallaby grass	
Thryptomene sp.		

** maybe toxic to stock*

*Note - Dominant species shown in **bold***

Vegetation communities in the Pallinup Catchment

WET SOIL

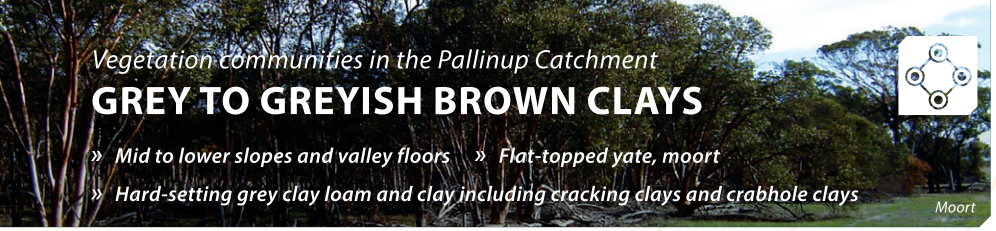
» *Swamps, lakes, non-saline hillside seeps* » *Flooded gum, flat-topped yate*

» *Various soils waterlogged < 30-80cm for majority of the year*

Flat-topped yate, pale rush understorey

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
Allocasuarina huegelliana	rock sheoak	
Banksia littoralis	swamp banksia	
Casuarina obesa	swamp sheoak	
Eucalyptus decipiens/ssp. chalara	moit	
Eucalyptus occidentalis	flat-topped yate	
Eucalyptus rudis	flooded gum	
Eucalyptus uncinata	hook-leaf mallee	
Eucalyptus vegrandis ssp. recondita	clay mallee	
Melaleuca cuticularis	salt-water paperbark	
Melaleuca rhaphiophylla	swamp paperbark	
Melaleuca strobophylla		clay, sandy silt
MID STOREY		
Acacia cyclops	coastal wattle	
Acacia saligna	orange wattle	
Allocasuarina lehmanniana	dune sheoak	
Billardiera fusiformis	bluebells	
Callistemon phoeniceus	fiery bottlebrush	
Hakea corymbosa	cauliflower hakea	
Hakea varia		
Kunzea micromera		
Kunzea recurva		
Leptospermum erubescens	roadside teatree	
Melaleuca hamulosa		
Melaleuca spathulata		seasonally wet flats
Melaleuca undulata		sand or clay
Melaleuca viminea		
Pericalymma spongiocaule		
Viminaria juncea	swish bush	
LOWER STOREY		
Acacia pulchella var. goadbyi		
Baumea articulata	jointed rush	indicator of fresh water
Brachysema celsianum	Swan River pea	
Cyathochaeta avenacea		
Ficinia nodosa	knotted club rush	sandier soils
Hakea marginata		
Hakea prostrata	harsh hakea	
Juncus pallidus	pale rush	
Melaleuca violacea		
Patersonia occidentalis	purple flag	

*Note - Dominant species shown in **bold***



Vegetation communities in the Pallinup Catchment

GREY TO GREYISH BROWN CLAYS

» *Mid to lower slopes and valley floors* » *Flat-topped yate, moort*

» *Hard-setting grey clay loam and clay including cracking clays and crabhole clays*

Moort

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
Eucalyptus annulata	open-fruited mallee	
Eucalyptus celastroides ssp. virella		
Eucalyptus densa ssp. densa		Ongerup area
Eucalyptus flocktoniae ssp. flocktoniae	merrit mallee	
Eucalyptus platypus/ ssp. platypus	moort	
Eucalyptus sporadica		
Eucalyptus thamnoides ssp megista	brown mallee	
Eucalyptus vegrandis ssp. recondita	clay mallee	
Hakea laurina	pincussion hakea	
Hakea preissii	needlie tree	
MID STOREY		
Acacia brachyclada		
Acacia harveyi		
Allocasuarina lehmanniana	dune sheoak	
Hakea corymbosa	cauliflower hakea	
Hakea varia	variable-leaved hakea	
Melaleuca acuminata		
Melaleuca brevifolia	mallee myrtle	
Melaleuca cucullata		
Melaleuca hamata	broom bush	
Melaleuca spathulata	purple honey myrtle	
Melaleuca thyoides	salt-lake honey myrtle	close to water
Melaleuca torquata		
LOWER STOREY		
Acacia bidentata		
Acacia cupularis		
Acacia erinacea		
Acacia ferocior		
Acacia glaucoptera (prostrate form)	clay wattle	
Acacia lasiocarpa var sedifolia		
Acacia redolens (prostrate form)	vanilla wattle	
Astartea ambigua		
Carpobrotus modestus	inland pigface	
Disphyma crassifolium	round-leaved pigface	
Hakea lissocarpha	honey bush	
Juncus pallidus	pale rush	
Templetonia sulcata	centipede bush	
Verticordia plumosa		

Note *- Dominant species shown in* ***bold***

Vegetation communities in the Pallinup Catchment

SALT LAKES

» *Variable soils and seasonally waterlogged*

» *Melaleuca thickets*

Salt lake in Balijup Wetland Suite

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
Casuarina obesa	swamp sheoak	
Eucalyptus phenax ssp. phenax		
Eucalyptus occidentalis	flat-topped yate	
Eucalyptus othostemon		
Eucalyptus spathulata	swamp mallet	
Eucalyptus thamnoides	brown mallee	on gravelly clay
Melaleuca cuticularis	salt-water paperbark	
Melaleuca strobophylla		
MID STOREY		
Callistemon phoeniceus	fiery bottlebrush	
Callitris pyramidalis	swamp cypress	
Enchylaena tomentosa ssp tomentosa	barrier saltbush	
Melaleuca acuminata		
Melaleuca adnata		
Melaleuca brevifolia		
Melaleuca cucculata		
Melaleuca thyoides	salt-lake honey myrtle	
Rhagodia preissii ssp. preissii		
LOWER STOREY		
Acacia redolens	vanilla wattle	
Atriplex semibaccata	creeping saltbush	
Austrostipa elegantissima	elegant spear grass	
Chloris truncata	windmill grass	
Disphyma crassifolium	round-leaved pigface	
Ficinia nodosa	knotted club rush	
Juncus kraussii	sea rush	
Maireana brevifolia	small leaf bluebush	

Note *- Dominant species shown in* ***bold***

GLOSSARY

» ***BIODIVERSITY***
Biodiversity is the variety of all life - the different plants, animals and micro-organisms - the genes they contain and the ecosystems of which they form part.

» ***COMMUNITY***
An assemblage of species populations that occur together in the same place at the same time.

» ***NSPNR***
North Stirlings Pallinup Natural Resources

» ***ECOSYSTEM***
Includes all the animals, plants and physical interactions of a defined space.

» ***RESILIENCE***
The ability of a community to return to its original state following displacement.

» ***RESISTANCE***
The ability of a community to avoid displacement.

» ***STABILITY***
Involves two components: resilience and resistance [8].

REFERENCES

1 » Mann, R.M. (2000). *Toxological impact of agricultural surfactants on Australian frogs*. Ph.D. Thesis, School of Environmental Biology: Curtin University of Technology, Perth.

2 » Pers. comm. J. Moore, Department of Agriculture and Food WA.

3 » Department of Parks and Wildlife Western Australian Herbarium (n.d.). *Florabase: the Western Australian Flora.* URL: https://florabase.dpaw.wa.gov.au/browse/profile/1175 - Accessed March 2014.

4 » Lund, D., & Twigg, L. (2009). *Farmnote: Guide to the safe use of 1080 poison* Note 381 November 2009. Biosecurity and Research (Lund), and Vertebrate Pest Research Section (Twigg), DAFWA, Forrestfield.

Twigg, L. & Lowe, T. (2009). *Farmnote: Bait stations and rabbit control* No. 38/2003. Vertebrate Pest Research Section, DAFWA, Forrestfield.

Twigg, L., Lowe, T. & Martin, G. *Farmnote: 1080 Characteristics and use* Bulletin 4776, October 2009. Vertebrate Pest Research Section, DAFWA, Forrestfield.

5 » McQuoid, N., Bradshaw, W., Inman, M., Mercer, J. & Stapleton, D. (1999). Considerations for improving biodiversity through revegetation: What does it take to mimic nature? In *WA Bankwest Landcare Conference: "Where community counts"* Esperance WA 8-10 September 1999. Esperance: WA Bankwest Landcare Conference Committee, pp. 68-72.

6 » South Coast Natural Resource Management. (n.d.). Dieback management for remnant vegetation on private property. [Brochure]. Albany, WA.

7 » Dieback Working Group. (2008). *Managing Phytophthora dieback in bushland: A guide for landholders and community conservation groups*. WA: Dieback Working Group, p. 28.

8 » Mackenzie A., Ball, A.S. & Virdee, S.R. (2001). *Instant Notes: Ecology* Second Edition. Oxford, UK: BIOS Scientific Publishers Ltd, pp. 190, 193.

9 » Stuart-Street, A. (2002) Soil-landscape information in *South Broomehill-Gnowangerup Area Rapid Catchment Appraisal* 2003. Resource Management Technical Report 236 compiled by Overheu, T. June 2002. Government of Western Australia: Department of Agriculture, pp. 9-13, 31.

10 » Stuart-Street, A. & Maygold, R. (in prep). Tambellup / Borden Area Land Resources Survey, Land Resources Series, DAFWA.

11 » Beard, J.S. (1979). The vegetation of the Albany and Mt Barker areas, Western Australia {kit}: map and explanatory text, 1:250,000 vegetation series SI 50-11, Vegmap Publications, Perth.

12 » Land Monitor Project (2001). Vegetation extent and change 1988-2000 Esperance Landsat scene (108-083) report. CSIRO Mathematical and Information Sciences.

13 » Sounness, S. & Whitfield, B. (Compilers) (2007) *Upper Pallinup Catchment Appraisal* Resource Management Technical Report 277. Government of Western Australia: Department of Agriculture and Food, pp. 14-15, 22.

Note: Soil-landscape information contained in vegetation community tables follows Stuart-Street, 2002 (9) and Stuart Street and Maygold (in prep.) (10), Beard 1979 (11) and Land Monitor Project, 2001 (12) cited Sounness & Whitfield, 2007 (13).

CONTACT NSPNR

89 Moir Street, Borden WA 6338 PO Box 41, Borden WA 6338

P 9828 1086 F 9828 1125

E admin@nspnr.com.au W www.nspnr.com.au