Corangamite Region Guidelines

Allocasuarina verticillata
Drooping She-oak

TAXONOMY

Division	Angiosperm
Subclass	Dicotyledonae
Family	Casuarinaceae

Previous Taxonomic Names
Casuarina verticillata Lam. (ANH et al 2005)
Casuarina stricta Aiton (ANH et al 2005)
Casuarina quadrivalvis Labill. (ANH et al 2005)

Taxonomic Identification Number 28220 (ANH et al 2005)

Taxonomic Status
Long-lived perennial

Common Names
Drooping She-oak, Coast She-oak, Hilloak; also various spelling variations such as She Oak, Sheoak, She oak, She-oak, Sheoke (ANBG n.d.).

MORPHOLOGY
Tree 4-10 m tall with separate male and female plants (dioecious).
Bark furrowed, branchlets drooping, grey-green, to 40 cm long. Internodes 10-40 mm long, 0.7-1.5 mm diameter, broadened at end near visible teeth.
Male plants with yellow-brown flower spikes, 3-12 cm long, 2-4 whorls per centimetre.
Female flowers red, globular. Large, cylindrical to barrel-shaped cones, to 20-50 m long, 17-30 mm in diameter, which usually have pointed valves (Costermans 1983; Walsh & Entwisle 1996).

SUBSPECIES
None

HYBRIDS
None known

SIMILAR SPECIES
Allocasuarina luehmannii (Buloke) - readily distinguishable by examining internode shape and length, length of male flower spikes, and the size and shape of cones (Walsh & Entwisle 1996).

GEOGRAPHIC RANGE
Found throughout Victoria, except in the Mallee and Gippsland and Alpine highlands. Prefers well-drained soils such as rocky coastal areas, basalt plains and hills and on dry, rocky highland hills and ridges. Also SA, NSW and TAS (Walsh & Entwisle 1996).

Lyons, Brooks and Craig (1974) found that in the Coolac Serpentinite belt in NSW where *A. verticillata* is one of the typical species, a highly significant plant-soil relationship existed between *A. verticillata* and zinc. They also noted that the distribution of *A. verticillata* in that region appeared to be controlled by higher potassium and nickel values in the soil.

BIOREGIONS

Central Victorian Uplands	Otway Plain	Otway Ranges
Warrnambool Plain	Victorian Volcanic Plain	

Greening Australia Victoria Inc
State Government Victoria Department of Primary Industries
Ballarat Region Seed Bank
CORANGAMITE CMA
exchange national vegetation knowledge service
Natural Heritage Trust Helping Communities Helping Australia
action Salinity & Water AUSTRALIA
Corangamite Seed Supply & Revegetation Network

PLANT COMMUNTIES
In Corangamite, *A. verticillata* is associated with grasslands and grassy woodlands on the volcanic plains, scrubs and woodlands along the coast, wet forests in the Otway ranges and dry forest ecosystems especially around central Victoria. Known to form pure woodland stands.

FRAGMENTATION
Fragmentation is recent, occurring since European settlement.

RELEVANT HISTORY & RESEARCH
Moncur et al (1997) states that there has been little studied regarding the reproductive biology of the Casuarinaceae family. No studies regarding floral biology with regard to management of seed production or seed orchards and controlled crosses were completed prior to the 1997 study by Moncur, Boland and Harbard.

Several studies on cockatoos highlight the importance of *Allocasuarina verticillata* as a food source. Schodde *et al* (1993) noted that Drooping She-oak was a significant species for a variety of parrots that feed on the fruit through out the year. Cleland and Sims (1968) and Cameron (2005) reported that the Glossy Black-cockatoo which has a very specialised diet, feeds almost entirely on Allocasuarina and Casuarina seeds.

Current research through the Corangamite Seed Supply Framework (DPI and GAV) and CSIRO is focused on population genetics of Drooping She-oak in linear roadside remnants, patches, isolated plants in paddocks and revegetation sites in the Corangamite region. Results from this research will be finalised in December 2006 and will provide clearer guidelines for seed collection and revegetation practises.

POPULATION DENSITY
Small stands are known along roadsides with some large stretches of 100 plants or more. There are also some large stands on private land and public reserves. Most stands across the region are small and isolated.

BREEDING SYSTEMS
FLOWERING
Separate male and female trees. Flowers all year. Male trees have yellow-brown flower-spikes. Female trees have red globular flowers (Walsh & Entwisle 1996).
Bonney (2003) describes a March-December flowering period for the species while Moncur et al (1997) notes flowering during winter months.

A natural stand of 95 trees in Canberra was the subject of a study by Moncur et al (1997). Flowering occurred from May-October (autumn & spring). Most trees in the stand were synchronised from June to mid-October, but once an increase of air temperatures occurred, abundance of flowers was reduced.

Female flowers have red stigmas, which turn brown within two weeks of being pollinated. Stigmas are receptive over their entire length, and are most successfully pollinated from the bottom third of the stigma. Few losses of flowers were observed between fertilisation and maturity (Moncur et al 1997).

POLLEN
Male flowers release pollen over a 3-9 week period depending on air temperature. Pollen germination was highest at 10°C and 15°C and poor at 5°C, 20°C and 25°C. Differences in the levels of pollen viability were recorded, both between individual trees, and for particular trees during different times during the flowering period. Each male flower contains around 650 000 pollen grains. Pollen may have a short life span but is shed over a long time allowing pollination of nearby female trees, depending on wind direction. Male trees are suitably adapted for wind pollination strategies. The total number of viable pollen grains in a given inflorescence was proven to produce 100% pollination, despite the presence of non-viable grains (Moncur et al 1997).

POLLINATION
Obligate out-breeder (Moran 1992; Walsh & Entwisle 1996; Moncur et al 1997).

In the Moncur et al (1997) study, individual female flowers could be receptive for over 12 weeks. The proportion of individual flowers pollinated increased gradually over this period. A number of female trees were

receptive 4 weeks prior to the male trees in the same stand shedding their pollen and were being pollinated from another, more distant stand. Time from pollination to 50% fertilisation, measured by swollen ovaries, took 53-83 days. Pollination is a gradual process which increases over time. These strategies allow a better mix of genes as each flower can receive pollen from a number of males and males can distribute pollen to many females.

POLLINATORS
Wind pollinated (Moran 1992; Moncur et al 1997).

Moncur et al (1997) concluded that any pollination occurring from birds feeding on seeds would be purely accidental, and that the species was pollinated by wind. On warm days pollen clouds were observed, indicating pollen transfer by wind.

SEED
SEED DESCRIPTION
Cylindrical or barrel-shaped woody cones 20-50 mm long and 17-30 mm in diameter. Valves in several rows, often pointed.
Seed 7-12 mm long, very dark brown in colour, with a flat papery wing attached (Walsh & Entwisle 1996). It becomes mucilaginous when wetted (Moncur et al 1997).
Information relating to seed weight and viability varies:

- 130-278 seeds/gram (GAV n.d.) to around 400 seeds/gram (Gowers 1990).
- 127-270 viable seeds/gram with an average seed viability of 58% (Langkamp 1987). Seed from a Canberra population study was found to have an average viability of only 27.4%, with a 25.8% germination rate at 25°C. Cones averaged 93 seeds, with an average seed weight of 0.93g. (Moncur et al 1997).
- 46-70 germinants/gram (GAV n.d.) to 57 germinants/gram at 15°C (Gunn 2001).

SEED CROP
Collect throughout the year, as seeds retained in cones on trees for long periods.
Collect cones closest to the trunk. Mature cones will be grey-brown in colour, but ensure valves remain closed. Immature fruits are tan brown, and immature seed is pale cream to orange in colour, while mature seed is brown (Bonney 2003).

SEED DISPERSAL
Birds (Schodde et al 1993; Moncur et al 1997; Bonney 2003).
Important constant food source for a number of parrots (Moncur et al 1997) including the black cockatoo (Schodde et al 1993).

At no time during Moncur et al's (1997) six month study were any significant quantities of seed dropped by *A. verticillata* trees. This confirms Turnbull and Martensz's (1982) findings, and supports their suggestion that fire may be required for seed to be released (Moncur et al 1997).

EXTRACTION & STORAGE
Place collected cones in a warm, dry area and seed will be released in a few days (Bonney 2003).
Seed with a pre-storage viability of 58%, was found to have reduced in viability to 50% after 16 years in storage at 20-25°C (Turnbull & Martensz 1983).
Seed stored at 3-5°C had a 10% germination rate after 5 years, and 83% germination rate after 10 years (Gunn 2001).

PROPAGATION
Can be propagated from fresh seed (Earl et al 2001), although Bonney (2003) advises that best results will be achieved from seed sown between one and eight weeks after collection.

Bonney (2003) states the ideal temperature for germination is 20-25°C, while Gunn (2001) gives the ideal temperature as 15°C. Moncur et al (1997) found that between 10-20°C Drooping She-oak germinated well. Studies by Turnbull and Martensz (1982) noted that *A. verticillata* from a coastal site at Bermagui germinated well at 25-30°C. This was a much warmer site than the Canberra study.

Pale foliage and poor growth may result unless seedlings are inoculated with soil bacterium (*Franks*

spp.) that can be obtained from the roots of parent trees. The bacterium occurs in fleshy and coral-like root nodules just beneath the soil surface. Dig up small quantity of nodules and grind using mortar and pestle. Dilute and water into seedlings (Earl et al 2001).

Root suckers can be transplanted during winter when soil is moist (Earl et al 2001).

An Ocean Grove study found that moderate shade treatment of 30% of full daylight for nine months between autumn and spring increased the growth rate of *A. verticillata* (Withers 1979a), but prolonged shading decreased the species drought resistance (Withers 1979b). Deep shade treatment of 8% of full daylight was detrimental to growth rates (Withers 1979a) and decreased drought resistance further (Withers 1979b).

TREATMENT OPTIONS
No treatment is required, although inoculation with appropriate mycorrhiza (soil bacterium) may improve results (GAV n.d.; Earl et al 2001). Moncur et al (1997) suggest that stratification should be a standard practice for this species. They found that stratification at 4°C for 4 weeks increased the speed of germination, although it did not affect the total germination rate.
Moncur et al (1997) found that the application of gibberellins (GA_3) had a slight beneficial effect on total germination rates.

GERMINATION TIME
See notes under 'Propagation' in relation to variation in optimal germination temperatures.
Published germination rates and times include:

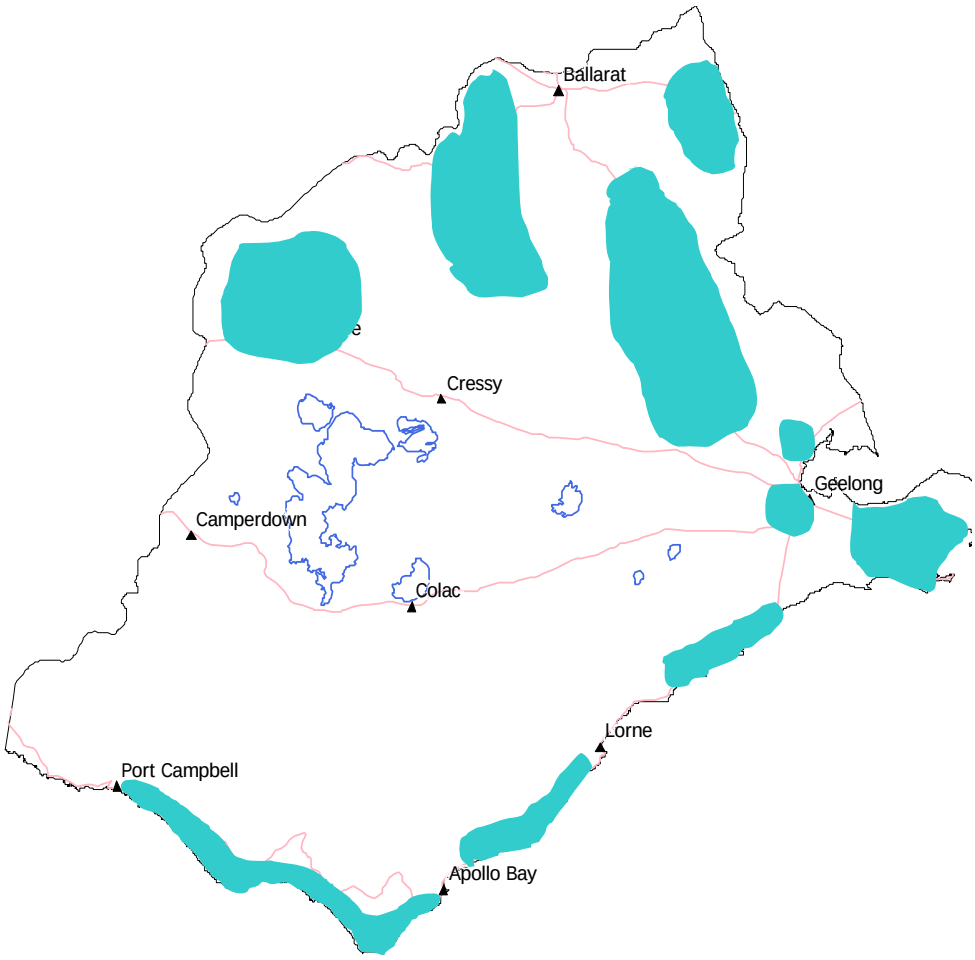
- Untreated seed took 5 days to reach 50% germination at 25-30°C (Fox et al 1987).
- Untreated seed from Ocean Grove took 35 days at a constant temperature of 26°C to gain near complete germination (Withers 1978).
- Untreated seed should germinate in 2-5 weeks at hot temperatures of up to 50°C (Earl et al 2001).
- Seed from a Canberra site reached 50% of final germination after 14 days, but continued to germinate for 12 weeks. Commencement of germination was delayed by lower temperatures (Moncur et al 1997).

FIELD ESTABLISHMENT
Well suited to direct seeding (Ralph 1994; Bonney 2003).
Sow into lightly tilled soils from late winter to early spring through a machine boot and press in (Bonney 2003).
Natural regeneration is from root suckers and seed, but it will also coppice to some extent. Highly palatable to livestock and rabbits, so generally requires protection to establish (Earl et al 2001).

SEED COLLECTION RANGE - *Allocasuarina verticillata*

Intermediate - within which, collection can be extended to formally contiguous remnants

Coastal populations of *Allocasuarina verticillata* vary in form to inland populations. These areas differ markedly in rainfall and geology. Separate collections should be maintained for inland and coastal areas.
Collections can extend to formally contiguous populations. Collect from a large number of female plants (30-50 plants) where possible. Collect from populations with relatively even numbers of both female and male plants. Branches should not be lopped as this impacts dramatically on future seed set. The cones can be hand picked. Collect greying cones as these are more mature than brown cones.



MAP*: Allocasuarina verticillata* broad distribution
DATA SOURCE: Flora Information System, Biodiversity and Natural Resources, DSE –May 2005

Broad distribution of remnant patches and scattered trees

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