Department of Conservation and Land Management
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# Population dynamics, seed biology and conservation of six endangered *Eremophila* species



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**November 1995**

# Population dynamics, seed biology and conservation of six endangered *Eremophila* species

**ANCA ESP Project No 353**

By

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FINAL REPORT SUBMITTED TO THE
ENDANGERED SPECIES UNIT
AUSTRALIAN NATURE CONSERVATION AGENCY

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

February 1996

Department of Conservation and Land Management
PO Box 104, Como, WA 6152

This study (ANCA ESP Project No 353) was funded by the Endangered Species Program of the Australian Nature Conservation Agency.

## ACKNOWLEDGEMENTS

Dr Robert Chinnock (Adelaide Botanic Gardens) assisted in plant taxonomy and field surveys during 1993. The logistical support of staff at the Department of Conservation and Land Management is gratefully appreciated: Mal Graham (Katanning); Mike Fitzgerald and Rodney Clifton (Merredin); Ken Borland (Moora); Andrew Chapman (Kalgoorlie); Dr Ken Atkins and Mike O'Donoghue (Perth). The Shire Council at Moora and Westonia assisted in the controlled burns. Dr Terry Houston (Western Australian Museum) and Dr Tony Postle (Western Australian Department of Agriculture) assisted in entomological identification. The staff at the Kings Park Botanic Gardens (Perth) are thanked for receiving all rare flora cuttings. The following colleagues are thanked for discussions on *Eremophila* taxonomy, the views of which have been quoted in the text and are the sole responsibility of the authors: Dr K. Atkins, CALM; Dr R.J. Chinnock, Adelaide; Prof Ghisaberti, University of Western Australia and Dr Ken Hodgkinson, CSIRO, Canberra.

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# 1. INTRODUCTION

*Eremophila* are shrubs and small trees which have revegetation, horticultural, medicinal and phytochemical potential (Richmond 1993a, 1993b; Richmond and Ghisalberti 1994a). Of the 179 *Eremophila* species in Western Australia (Richmond and Chinnock 1994), 14 have been listed as threatened (Declared Rare Flora) under the Western Australian Wildlife Conservation Act whilst a further 64 have been classified as rare but poorly known (Priority Flora, K. Atkins 1995). Six species were targeted in this project for field and laboratory studies: *E. caerulea* subsp. *merrallii*, *E. inflata*, *E. nivea*, *E. resinosa*, *E. verticillata* and *E. viscida.*

## 1.1 Research Review

Many *Eremophila* may be regarded as disturbance opportunist species since they readily reappear from sites after roadside or open clearing has occurred. According to Chinnock (1982) plant suckering is the most obvious form of *Eremophila* regeneration in disturbed sites due to root system disturbance or damage and destruction of the aerial parts of the parent plant. This situation is further enhanced by run-off from rainfall events, especially if roadside clearing is involved. This has been illustrated by the suckering of *E. densifolia* near Forrestania (WA) in 1978 due to possible road verge clearing (or due to the previous dying back of the plant to ground level during a drought; Chinnock 1982). Prior to the abundant suckering after disturbance, this population consisted of only a few scattered adult individuals. Other species have been observed to regenerate following roadside disturbance apparently from seed (Atkins pers. comm. 1992). , Seed regeneration of *E. nivea* has also been noted along roadsides near Moora (WA). Chinnock (pers. comm. 1992) has commented that mass germination of many *Eremophila* species from fruits is common after roadside disturbance due to a number of factors, primarily a reduction in competition from other flora and due to the improved increased soil-moisture status along roadside verges.

### 1.1.2 Fire ecology

*Eremophila* ecology (specifically plant biomass (kg/ha) and germination rate) has been investigated in association with the effect of fire on shrub eradication. *E. sturtiii* and *E. mitchellii* in NSW and Qld have been the focus of attention because of their woody nature. Ralph (1991) comments that these two shrubs resprout after fire (see also Purcell 1964; Beeston and Webb 1977; Johnson and Purdie 1981) though seedling recruitment after a burn is minimal (Hodgkinson pers. comm. 1991). It is therefore known as a resprouter, since it survives the fire by regenerating shoots from protected below- or above-ground buds. The plant is known as an obligate seeder where the shrub succumbs to the fire but subsequently recruits from the seed-bank. This is due to the fruits non-response to a heat pulse (Hodgkinson 1991). Beeston and Webb (1977) noted that for *E. mitchellii*, after fire, it regenerates from buds on a swelling at a base of the trunk,

though plant vigour after a fire is reduced (Purcell 1966). Killing of the exposed buds is also positively correlated with fire intensity.

The effect of fire on the density of three Qld woody weed *Eremophila* species has been studied by Pressland *et al.* (1986). *E. gilesii* appears to be susceptible to fire, with *E. sturtii* the least affected, and *E. bowmanii* affected at an intermediate level. The latter two species regenerated mainly from the original shrubs (at the base of the plant), though *E. gilesii* regenerated from fruits preceding the fire. However, this rate of seedling establishment was greater in unburnt areas suggesting that burning does effectively kill many seedlings. Since mature bushes of *E. gilesii* are highly susceptible to fire (Latz 1982), their regeneration is totally reliant on seedling establishment. Pressland *et al.* (1986) comments that since germination is most effective in cooler winter months after rains, spring fires would have the advantage of killing both the mature shrubs and the young seedlings. Furthermore, *E. bowmanii* and *E. sturtii* may also be affected by a very hot summer fire which may reduce basal and aerial growth, and provide maximum fuel to generate sufficient heat to damage subterranean growing points (Pressland *et al.* 1986).

Plant growth and seedling survival following fire have also been described in western NSW, for *E. sturtii* and *E. mitchellii* (Ralph 1991). Leigh and Noble (1981) comment that mature bushes of these two species in the Coolabah region of NSW are rarely killed by a single spring fire (<15% shrubs). However, young plants up to 15 cm high (1-2 years old) appear to be more fire-sensitive (with 60% and 40% killed by one fire respectively). Foliage of some of the *Eremophila* shrubs in the semi-arid rangelands have been recognised as containing flammable compounds which enable the leaves to burn fiercely once ignited though the variations in flammable compounds between young and old shrubs has not been recorded (Leigh and Noble 1981).

Two of six threatened eremophilas in this project, *E. caerulea* subsp. *merrallii* and *E. nivea* are resinous and may not be fire resistant (Ghisaberti pers. comm. 1993). Whilst other species such as *E. longifolia* and *E. latrobei* contain essential oils but are not resinous (Ghisaberti pers. comm 1993) and primarily form suckers after fire. At present it is unclear how important essential oils or resins are in a plant's ability to either withstand or be susceptible to fire.

Adults of woody weed *Eremophila* species appear to readily survive frequent fires, though seedlings of most species are killed by fire. As a consequence, fire regimes can be designed to decrease woody weeds in rangelands, once life histories and fire-survival strategies of individual species are understood (Hodgkinson 1991). In some situations Eremophilas have been recorded as vigorously germinating after fire, as in the case of *E. serrulata* near Roto (NSW) after the January 1985 bush fires. This may be due to a combination of good rains in October and November of that year (188 and 38 mm respectively), increased nutrient availability (this area contained dead and burnt-out mulga) and reduced competition from other plants. Nevertheless, most *Eremophilas* recovered, with *E. longifolia* and *E. oppositifolia*

root suckering whilst *E. glabra*, *E. sturtii* and *E. mitchellii* regenerated from regrowth (Houghton 1986).

Techniques for determining the likelihood of a species being a resprouter as opposed to a reseeder, are associated with the concentration of starch stored within the root system. This is always substantially greater in concentration in resprouter species, since they have a slower growth rate, and a larger proportion of their biomass below ground. A greater proportion of the parenchyma (primary ray potential storage tissue within the main lateral root) is available for starch storage. The starch concentration for all of the target species (excluding *E. caerulea* subsp. *merrallii* due to unavailability of material) was compared along with the known resprouter species *E. longifolia*, following the procedures outlined by Bowen (1991). This includes assessing the number of starch grams per ray, along with the % area filled, which gives a relative starch density, and visual rating out of ten. This visual density (0-10) allows all species to be compared relative to each other, using *E. longifolia* as the "standard" resprouter species.

## 1.2 Project Scope

A preliminary field survey of the habitats for the six species was carried out during winter 1993 to establish habitat requirements, investigate population structure, determine conservation status and management requirements, as well as set up monitoring sites for each species. This was followed by a survey of these communities during the flowering season (October 1993) to establish potential sites for burn trials. The second trip was accompanied by the *Eremophila* authority Dr R.J. Chinnock (Adelaide Botanic Gardens and State Herbarium). A fruit collection trip was carried out during January 1994 to obtain seed material of all species (excluding *E. caerulea* subsp. *merrallii*).

### 1.2.1 Germination requirements

A series of germination experiments have been carried out on the rare species *E. nivea; E. viscida; E. verticillata*, where seed material has been readily available after field collections in October 1993 and January 1994. Optimum germination requirements for each species were assessed using the temperature records for the winter months (18-20$^{o}$C), recorded at the nearest meteorological stations adjacent to the study sites. Seeds and fruits were germinated over a 40 day period (n=60). For germination testing, all seeds were excised from the fruit, except for *E. verticillata* since the fruits are delicate and the seeds are too small for excision work. In this situation, whole fruits were used in the germination experiment.

### 1.2.2 *Eremophila* burn trials

Burn sites were established for *E. nivea*, *E. resinosa* and *E. verticillata* during the spring of 1993. The vegetation community of each of the burn-sites was also described. These results will be compared with the known concentrations of starch in the roots of all target species (excluding *E. caerulea* subsp. *merrallii*) to confirm

whether a species posses characteristics of either resprouter as opposed to a reseeder (see section 1.3).

### 1.2.3 Study site design and assessment

A circular study plot design was selected since it could be partitioned into $30^{o}$ or $45^{o}$ sectors where the exact location of individual plants could be monitored closely (Lindsey, Barton and Miles 1958; Mueller-Dombois and Ellenberg 1974). The diameter of the plots was either 12 m or 20 m, with a total area of 295 and 491 $m^2$ respectively. Study plot design varied due to differences in plant community density for each specific species. Each plot contained *Eremophila* species which were dominant throughout each study site. Whilst homogenous stands of *Eremophila* species were the preferred choice, some study sites consisted of up to two other Poverty bush species, though their numbers were restricted. Only the species of interest within each study site was monitored. Each *Eremophila* plant within a study site was mapped within the $30\text{-}45^{o}$ sector in terms of distance along the sectors' left or right hand side axis from the centre of the study plot. The distance between the shrubs main stem and the side of the sector (perpendicular to the length measurement) was also recorded. Initially the study sites were visited during 1993 (winter). Regular monitoring in the future (summer and winter) should be carried out to assess plant responses to rainfall and optimum temperatures. Plant height (H), widest ($W_1$) and perpendicular ($W_2$) widths of all *Eremophila* plants located within each site were measured. Plants were divided into two groups, depending on form. The inverted cone shape describes *E. caerulea* subsp. *merrallii, E. inflata, E. resinosa* and *E. verticillata.* The upper half spheroid shape describes *E. nivea* and *E. viscida.* Canopy volume for the inverted cone plant form maybe calculated using the geometric formula ($^1/3r^2h$) (see Ludwig, Reynolds and Whitson 1975). The following formula for canopy volume can be used for shrubs with an upper half spheroid form ($4/3\ ^1 * W_1/2 * W_2/2 * H/2$), (see Witkowski, Lamont and Connell 1991).

### 1.2.4 Germination and seedling establishment

Newly established seedlings were monitored at each visit. When new seedlings were observed, they were tagged, labelled and measured (height and width) by sector location. In most cases the number of seedlings produced per fruit can be individually assessed. Germinants can be recorded as juveniles during subsequent field site visits. A two year period was considered necessary for the juvenile plants to be regarded as adults (Wilcox 1960; Hacker *et al.* 1991).

# 2. *E. CAERULEA* (S.MOORE) DIELS SUBSP. *MERRALLII* BRUCE ROCK EREMOPHILA

## 2.1 History, Ecology and Taxonomy

First collected near Bruce Rock in October 1927 by O.H. Sargent, and again in same area in 1980. *Eremophila caerulea* subsp. *merrallii* is characterised by a sprawling prostrate habit (Mollemans, Brown and Coates 1993), 0.2 m tall and 0.5 m across with densely hairy branchlets (Elliot and Jones 1984). At Bruce Rock, it is located in open shrub mallee on light coloured stony clay loam soil. It also occurs in lateritic soils (Elliot and Jones 1984). Flowers are violet, blue or purple with dark spots, the corrolla being tubular, 1 cm long (Elliot and Jones 1984). Leaves are thick, warty, 6-7 mm long, narrow, linear and subterete. Flowering is between August-January (Conservation and Land Management 1991). It is an entomophilous species.

## 2.2. Distribution and Conservation Status

Three *E. caerulea* subsp. *merrallii* populations are known:

Population 1A- Shire road verge (wheatbelt road reserve-narrow) west of Bruce Rock, initially 18 plants in 1980, in *Eucalyptus* shrubland on pale sandy clay soil. Current population of 18 plants.

Population 1B- Located on private property, as in Population 1A, initially 5 plants. Area fenced. Three plants currently exist.

Population 2- Mining tenement, SSE of Southern Cross and SE of Cheriton Find. A sole plant in 1988 in poor condition. Unable to be relocated on 20.5.90.

Population 3- Jaurdi Station (CALM Reserve), NNE of Koolyanobbing, East of Hunt Range. 2000+ plants in undisturbed site in 1991. Plant community consists of *Eucalyptus* spp., *Neurachne* spp., annual herbs, *Acacia* spp. (open scrub). Healthy population of >2000 shrubs recorded in December 1994.

Total plant number known: 2022+.

## 2.3 Seed germination requirements

Fruit material from this species was unavailable, so no germination experiments were undertaken.

## 2.4 Fire Tolerance

No information is available regarding this species' response to fire.

## 2.5. Recommendations for Conservation and Management

### 2.5.1 Liaison with landowners and shires

Continued liaison is needed between CALM and the landowner and local Shire in relation to any operations which may impact on population 1.

### 2.5.2 Protection from grazing

Grazing by sheep has been previously recorded at the population 1B. Although this population has now been fenced occasional monitoring should continue.

### 2.5.3 Protection from accidental destruction

Mining activity is a possible threat at population 3. This region is actively mined and the population should be monitored on a regular basis to ensure future mining activity (eg drilling, gridding) does not pose any threat. It was noted that an access track (used for mining purposes) goes through the population.

### 2.5.4 Protection from fire

No information is available on this species' response to fire. However, it has been observed to sucker when roots are disturbed suggesting that the roots contain a high starch content and regeneration after fire is likely. Further research is required at Population 3 with its greater species density.

### 2.5.5 Weed control

Exotic weeds are a possible threat at populations 1A/1B, and this should be occasionally monitored.

### 2.5.6 Linear markings

Linear markings are situated at site 1A. Road markings are not required at any other site.

### 2.5.7 *Ex situ* conservation

Although not currently a high priority, seed collection from all populations and *ex situ* conservation of this species is advisable. This may be achieved through cultivation and long-term seed storage. Currently, germination attempts at Kings Park Botanic Gardens (KPBG) has been unsuccessful. However, shoots and nodes have been established as cuttings at KPBG..

### 2.5.8 Rehabilitation and Recovery

No translocation or recovery actions are currently required for this species. However, if seedlings become established along the road margins (where roadside runoff is greatest) it is suggested that where possible these seedlings are transplanted into similar adjacent habitats away from the road..

### 2.5.9 Monitoring

A monitoring site has been located at population 3 on Jaurdi Station which is a Nature Reserve. It occurs within a *Eucalyptus* woodland-*Eremophila interstans* understorey on pale sandy clay loam, with >2000 individuals. This species was surveyed during December 1994, and a monitoring site was established (Appendix 1). The area which encompasses Jaurdi Station requires further survey work, since the population located at this reserve was only discovered in 1990. There is a possibility that further populations of this species will be identified. A closely related species, *E. caerulea*, occurs throughout the Southern Goldfields.

# 3. *E. INFLATA* C.GARDNER SWOLLEN OR BELL-FLOWERED EREMOPHILA

## 3.1 History, Ecology and Taxonomy

First recorded in the late 1800s from Lake Moore and Mt. Holland where it is now presumed extinct. This species currently belongs to the genus *Eremophila*, though it will be reclassified as *Calamphoreus inflatus* (Gardner) Chinnock (Myoporaceae) (Chinnock 1982 and pers. comm. 1993). It will be the only *Calamphoreus* species in Australia (Chinnock 1991). It is a shrub to 2 m (0.6-2.0 X 0.6-1.5 m, Elliot and Jones 1984), with warted, resinous branches. Appearance is swollen, with linear-oblanceolate leaves 3 cm long and 3.5 cm wide. The leaves may have a short hooked tip, narrowed at the base. Occurs in woodland (*Eucalyptus flocktoniae* and *E. calycogna* in gently undulating terrain in brown clay loam) East of Hyden (Hopper *et al.* 1990), between Lake King and Mt. Holland and within the region of Mt. Moore (Chinnock 1982). Soils are typically brown clay loam to red brown clay. Flowering is generally between November-December (Hopper *et al.* 1990) though it has been recorded in flower as early as May in exceptional seasons (Mollemans, Brown and Coates 1993). Chinnock (1982) describes the corolla as pale to rich purple (entomophilous species), though it may also be pink. The fruits are beaked and hairy (Elliot and Jones 1984), where it partially splits at the apex (Chinnock 1982). It is considered short lived (<10 years) following the decline of monitored populations (Mollemans, Brown and Coates 1993).

## 3.2 Distribution and Conservation Status

Six *E. inflata* populations are known:

Population 1A- Located on private property at Lake King-Norseman road, East of Lake King crossroads, with an initial population of 17 plants in 1980. Eighteen plants currently exist.

Population 1B- Located on shire road verge in vicinity of population 1A. Initial population of 55 plants in 1980. During 1985 the shire graded the road verge, and reduced the population to 13 plants.

Population 2- Located on Vacant Crown Land, S of junction of Forrestania/south-crossroads and Hyden/Norseman Rd, east side. Initial population of 2 plants in 1987. Current population status is 4 plants.

Population 3- Located on Vacant Crown Land, 9.7 km south of population 2. Initial population of 1 plant in 1988. Roadside markers installed in 1991. Current population status is 1 plant.

Population 4- Type specimen collected in 1929 on Vacant Crown Land, north of Forrestania/south-crossroads and Hyden/Norseman Road. Population extinct.

Population 5- Shire road verge, SE of Marvel Loch, consisting of 175 (mature 102; seedlings 73) plants occurring on M.Loch/Yellowdine road for 6 km in 1990. Some damage to population by machine movements. Plant community interspersed with *Eremophila decipiens* and *E. glabra*. Current population status 175 plants?

Population 6- Shire road verge, SE of Marvel Loch, consisting of 50 plants (mature 40; seedlings 10) in 1990. The vegetation is made up of *Eucalyptus* spp., *Eremophila ionantha*, *E. scoparia, E. decipiens* and *Stipa* grass. Excellent condition population, with some adults 2 x 2 m. Three adults and 1 seedling affected by Cottony Cushion scale (<1% cover). Current population status 50 plants.

NB This species occurs within belts of greenstone rock, favouring alluvial and colluvial deposits. It has been recorded along the shoulder of graded roads suggesting that it may be disturbance opportunist.

Total plant number known: 261.

### 3.3 Seed germination requirements

Fruit material from this species has been unavailable, so no germination experiments have been undertaken.

### 3.4 Fire Tolerance

No information is available on response to fire. However, a visual assessment of the relative density of starch grains within the roots of this species (in comparison with the roots of the known suckering species *E. longifolia*) illustrates that the roots posses no starch grains (visual rating of 0), and would thus be a prominent reseeder species rather than a resprouter.

### 3.5 Recommendations for Conservation and Management

#### 3.5.1 Liaison with landowners and shires

The majority of populations and plants occur on shire road verges, indicating that regular liaison with local shires and monitoring is essential. Management of population 1 will also require liaison with the property owner as well as the local shire.

### 3.5.2 Protection from grazing

There is no documented evidence of grazing by sheep or rabbits.

### 3.5.3 Protection from accidental destruction

Shire road verge grading is a serious threat to Population 1, and has resulted in previous destruction of plants and associated vegetation. Mining industry infrastructure (roads) is a significant threat to Population 5, with recent machine movement found to be impacting on several plants. Since this region is actively mined, the population should be monitored on a regular basis to determine if mining activity (eg drilling, gridding) may threaten populations.

This species appears to be a disturbance opportunist so limited roadworks and mining activity may not necessarily pose a major threat if total habitat destruction is avoided.

### 3.5.4 Protection from fire

No information is available on this species' response to fire. However, the roots displayed no evidence of starch grains which indicates that fire maybe a distinctive threat to this species. However, Mollemans, Brown and Coates (1993) have commented that it is known to sucker when their roots are disturbed, signifying that the roots may contain some starch. Although further research is required on this species to accurately assess its response to fire short interfire periods (<5 yrs) are likely to be detrimental.

### 3.5.5 Weed control

Exotic weeds are a possible threat at population 1A/1B which should be monitored by CALM.

### 3.5.6 Linear markings

Linear markings are situated at Population 3. Road markings are not required at any other site.

### 3.5.7 *Ex situ* conservation

Given the low number of individuals seed collection from all populations and *ex situ* conservation of this species is advisable. This may be achieved through cultivation at Kings Park and Botanic Gardens and long-term seed storage in the CALM Threatened Flora Seed Centre. Currently, cuttings have been successfully raised at KPBG. Currently, no fruit material is available in any seed bank collections.

### 3.5.8 Rehabilitation and Recovery

Although no translocation or recovery actions are currently recommended the conservation status of this species should to be closely monitored and recovery actions considered if numbers get much lower. If seedlings become established along the road margins (where roadside runoff is greatest), it is suggested that where possible they are transplanted into similar adjacent habitats away from the road.

### 3.5.9 Monitoring

A monitoring site has been located at Population 6 (established June 1993) where 73 plants along the road verge are being monitored for insect attack and germination/recruitment studies (Appendix 2).

An assessment of this site was carried out of subgroup 2 (identified by Frans Mollemans 20/6/93) of three clusters of shrubs made up of 1, 8 and 34 plants respectively. These clusters have changed in number to 1, 9, and 63 respectively. The majority of plants appear healthy, with green growth. Four dead plants were located within this sub-group with 13 seedlings and 60 adults. Each plant was measured (height, widest and perpendicular) and condition status of each individual made (ie adult/seedling/insect attack). Three adults and one seedling appeared to be infected by Cottony Cushion scale, though the cover was <1%. These plants were located within a drainage line where a water pipe had been laid, demonstrating that soil disturbance has encouraged seed germination. The location of a further 58 plants identified by Mollemans is within a drill pad and access road. It is now estimated that some 100 plants occur within this.

Half-yearly surveys of the monitoring site should be carried out, to determine growth habits and germination requirements in the field.

# 4. *E. NIVEA* CHINNOCK SILKY EREMOPHILA

## 4.1 History, Ecology and Taxonomy

The original population discovered east of Three Springs is now presumed extinct. A shrub to 1.6 m high (1.0-2.5 x 0.7-1.5 m, see Elliot and Jones 1984), with greyish-white tomentum foliage and lilac flowers to 2.5 cm long (entomophilous species). Hopper *et al.* (1990) notes its distribution as occurring in brown (sandy soils overlying) clay-loam under scattered eucalypts west of Three Springs. Flowering is between August-October (Hopper *et al.* 1990; in Population 1B flowering was recorded during October). Propagation may be from seed or cuttings which strike readily (Elliot and Jones 1984). The species has been raised from cuttings at Kings Park and Botanic Gardens and by the Three Springs Shire within the town as an ornamental plant. It is also currently a popular garden plant grown as an ornamental species, especially in Western Australia and South Australia. The fruits have been observed to be prominently beaked, splitting at the apex (Chinnock 1986), and are quadrilocular with one ovule per loculas.

## 4.2 Distribution and Conservation Status

Five *E. nivea* populations are known:

Population 1A- Located on a shire road verge north-east of Three Springs. Initial population of 5 plants in 1987. The population is threatened by weed invasion. Current population size of 2 plants.

Population 1B- Located on private farm land, immediately adjacent to Population 1A. Initial population of 3 plants in 1990. Population currently 28 plants (2 adults and 26 juveniles approximately 2-3 years old). Two mortalities also recorded.

Population 2- Located on shire road verge north of Three Springs. Initial population of 15 plants in 1990. Other plant community made up of *Symonanthus aromaticus*. Some weed invasion occurring throughout road verge. Current population of 20 plants (17 adults and 3 seedlings) in 1993.

Population 3- Located on shire road verge 1 km south south east of Population 2. Initial population of 65+ plants in 1990. Rubbish dumping along road verge (eg tyres, masonry, household waste) is a current threat. Several shrubs are infected by Lepidoptera galls which tend to change the form of the shrub though it does not threaten the shrubs development. Several shrubs are >2 m, with 5 shrubs >3 m. Current population of 93 plants (86 adults, 7 seedlings and 6 mortalities) in 1993.

Population 4- Type specimen collected in 1960 on shire road verge, SW of Morawa. Population extinct.

Population 5- Shire road verge, N of Three Springs. Initial population of 1 plant in 1991. Plant is partially damaged. Current population of 1 plant.

Population 6- New population on private farm land, 200 m South of Population 5. Initial population of 285 plants in 1993. Current population 285 plants.

Total plant number known: 429

### 4.3 Seed germination requirements

The fruits have been observed to be prominently beaked, splitting at the apex (Chinnock 1986), and are quadrilocular with one ovule per loculas. Fruits have been collected during summer 1993 for the CALM Threatened Flora Seed Centre, and for germination and fruit productivity testing. Seeds excised from fruits first germinated after 6 days (1.4%), with 21.4% germination occurring after 40 days.

### 4.4 Fire Tolerance

A controlled burn was undertaken during Winter 1994 on a sub-section of Population 6. This species appears to be partially fire tolerant since its foliage is not highly flammable compared with other species (eg *E. resinosa*). Monitoring of this burn trial should be undertaken over the next season to ascertain whether suckering or reseeding has taken place. A visual assessment of the relative density of starch grains within the roots of this species resulted in a visual starch rating of 5, suggesting that this species is partially fire tolerant.

### 4.5 Recommendations for Conservation and Management

#### 4.5.1 Liaison with landowners and shires

Populations 3 and 6 are the largest in number, with the latter population occurring on remnant vegetation on private property. It is recommended that the landowner be encouraged to maintain all fences and farm infrastructure which support the continued exclosure of this species. Although Population 3 is continuing to increase in number, rubbish dumping in the area may present a threat. All road verge populations should be monitored and close liaison maintained with the appropriate Shires.

#### 4.5.2 Protection from grazing

There is evidence of grazing by kangaroos at Population 6. Branch stems of adult plants were also damaged at this population by the Port Lincoln Ringneck parrot (*Barnardius zonarius)*. Populations on private land should be protected from stock grazing particularly if seedlings are present.

### 4.5.3 Protection from accidental destruction

Road maintenance is a serious threat at Populations 1A, 2, 3 and 5 (see section 4.2) and close liaison should be maintained with the appropriate Shires.

### 4.5.4 Protection from fire

This species appears to be partially fire tolerant since its foliage is not highly flammable and a visual assessment of the relative density of starch grains within the roots of this species resulted in a starch rating of 5 (see Table 1). However, where possible it is recommended that this species be protected from frequent fire.

### 4.5.5 Weeds

Population 1A/1B should be monitored for increased weed invasion and if necessary control strategies developed.

### 4.5.6 Linear markings

Linear markings are located at Population 3. Populations 1A and 5 also require road markers.

### 4.5.7 *Ex situ* conservation

Few populations and low numbers of individuals indicate that seed collection from all populations and *ex situ* conservation of this species is advisable. This may be achieved through cultivation at Kings Park and Botanic Gardens and long-term seed storage in the CALM Threatened Flora Seed Centre. Populations should be targeted for seed collection in mid- December-January. Currently, no fruit material is available in any seed bank collections.

### 4.5.8 Rehabilitation and Recovery

No translocation or recovery actions are currently recommended for this species. However, if seedlings become established along the road margins (where roadside runoff is greatest), it is suggested that where possible these seedlings are transplanted into similar adjacent habitats away from the road. Because numbers are low, close monitoring should be carried out on all populations.

### 4.5.9 Monitoring

A monitoring site has been located at Population 6 during June 1993 where 47 plants have been recorded for ecology and germination/recruitment studies (Appendix 2). The majority of plants appear healthy, with 38% (18 plants) of the population being at the seedling stage. Of these 2 seedlings recorded two seedlings from one fruit, the seedling being termed as a "two in one". Each plant was measured (height, widest and perpendicular) and condition status of each

individual commented upon. No insect damage has been recorded within this monitoring site.

Half-yearly surveys of these site should be carried out, to determine growth habits and germination requirements in the field.

# 5. *E. RESINOSA* F.MUELL. RESINOUS EREMOPHILA

## 5.1 History, Ecology and Taxonomy

This species was first described by Bentham in 1870. A low spreading shrub 60 cm-1.2 m high (0.5-1.0 m x 0.5-1.0 m, Elliot and Jones 1984) with white densely tomentose branches and thick alternate wedge-shaped leaves 1 cm long by 0.3 cm (Hopper *et al.* 1990). Young sticky growth occurs. Leaves are erect to spreading, greyish green, sparse to dense covering of short hairs, margins entire, apex pointed or blunt. This leaf arrangement which occurs in opposite pairs has only been observed in ten other *Eremophila* species (Chinnock 1982). This species is found on sandplain (light brown sandy clay loam soils) between Yellowdine and Wyalkatchem, only on disturbed road verges and on a partly disturbed rail reserve (Mollemans, Brown and Coates 1993). Flowering is between September-January (Hopper *et al.* 1990). The flowers are tubular, violet and about 1.5 cm long (Elliot and Jones 1984), and is an entomophilous species.

## 5.2 Distribution and Conservation Status

Sixteen *E. resinosa* populations are known:

Population 1- Located on a shire road verge North of Westonia. Initial population of 37 plants in 1987. Population extends for 1.5 km along road verge on both sides of road. Shire grading activity has been known to have destroyed several plants in this locality. MRD road markers are in place. Population stable with 37 plants and 1 mortality recorded in 1993.

Population 2- Located on reserve land (RES 37256) South of Koorda. Initial population of 14 plants in 1991. Population stable at 14 plants.

Population 3- Located on road reserve NNE of Walgoolan (Westonia Shire). Initial population of 46 plants in 1989. Population stable at 46 plants.

Population 4A- Located on rail reserve land NW of Nungarin Townsite. Initial population of 3 plants. Population stable at 3 plants.

Population 4B- Located immediately N of Population 4A on Rail Reserve land. Initial population of 1 plant. Population stable at 1 plant.

Population 5- Located on Shire road verge NW of Westonia. Initial population of 2 plants in 1991. Population stable at 2 healthy plants in 1993.

Population 6- Located on shire road verge East of Burracoppin. Initial population of 15 plants in 1992. This species occurs in Open low woodland dominated by *Eucalyptus salmonophloia* and a mixture of *Acacia* and *Grevillia*

species. Some plants resprouting from base, though the cause is unknown. Population stable at 15 plants.

Population 7- Shire road reserve North-West of Westonia. Initial population of 1 plant in 1991. Current population of 1 plant.

Population 8- Shire road reserve North-West of Westonia. Initial population of 1 plant in 1991. Current population of 1 plant.

Population 9- Shire road reserve and private farmland North-West of Westonia. Initial population of 12 plants on shire road verge and 1 plant on farmland in 1992. Population is currently threatened by weed invasion and road grading. Current population of 20 plants (no seedlings) in 1993.

Population 10- Shire road reserve North-West of Westonia. Initial population of 8 plants in 1992. This population is seriously threatened by wind blown medic seed which are covering plants up to 60 cm. Current population of 9 plant in 1993.

Population 11- Shire road reserve North-West of Westonia. Initial population of 1 plant in 1992. Current population of 1 plant in 1993.

Population 12- Located on shire road verge West of Westonia. Initial population of 45 plants in 1992. This species occurs in Open low woodland dominated by *Eucalyptus salmonophloia*, *E. sheathiana, E. salubris* and a *Melaleuca* species. Plants which occur adjacent to fenceline appear to be grazed by sheep. Most plants grow prostrate along ground surface then send shoots and branchlets vertically up. Current population of 37 adults (25 adults and 2 mortalities on West side and 12 adults along East fenceline in 1993.

Population 13- Located at Shire Reserve No.20857 West of Westonia. Initial population of 64 plants in 1992. This species is scattered throughout a *Eucalyptus transcontinentalis* woodland. The majority of shrubs appear to have little recent vegetative growth and are in poor condition. This area has been traditionally used for household and industrial rubbish. A detailed survey has revealed 215 plants (214 adults and 1 seedling) in 1993.

Population 14- Located at Shire road reserve South of Koorda Initial population of 101 plants (100 adults and 1 seedling in 0.45 ha) in 1992. Population extends for 1 km on either side of road verge. Roadside markers installed. Some plants growing through fence. Current population of 100 plants.

Population 15- Located on Shire road reserve North of Westonia (Nungarin Shire). Initial population of 5 plants in 1992. Population extends for 1 km along shire road verge. Current population of 5 plants.

Population 16A- New Population located on Shire road reserve South of Westonia. Initial population of 11 plants along Eastern road side in 1993.

Population 16B- New Population located approximately 100 m North-West of Population 16B. One hundred and fifty plants (120 adults and 30 seedlings) occur in an area of 100 $m^2$. Potential threats are car tracks which occur throughout the area as well as this area being used as dumping ground for household and industrial waste. Seedlings appear vigorous and healthy. A fire appears to have occurred through this area within 10 years due to the scorched marks on *Eucalypts* species.

Total plant number known: 713.

## 5.3 Seed germination requirements

The fruits have been observed to be ovoid, 6 mm in length. They are hirsute in characteristic, with the style attached. The fruits enclose two locules, within which 2 seeds may be enclosed (Richmond 1993). No germination experiments have been carried out since fruit material was unavailable.

## 5.4 Fire Tolerance

A controlled burn was undertaken during Winter 1994 on 14 adult plants, which were in a senescing condition. This sub-sample represented 6% of Population 13, in an area of 12 x 7 m. The controlled burn was inspected during the summer of 1994. With the exception of one individual adult plant, all other shrubs within the trial were totally burnt by the trial burn. Its foliage appears to be highly flammable. Monitoring of this burn trial should be undertaken over the next season to ascertain whether reprouting or reseeding has taken place. Whilst no recruitment was recorded from reseeding activity, this may be due to unfavourable rainfall patterns. A visual assessment of the relative density of starch grains within the roots of this species resulted in a visual starch rating of 5, indicating that it may posses characteristics of a resprouter.

## 5.5 Recommendations for Conservation and Management

### 5.5.1 Liaison with landowners and shires

The majority of Populations occur on shire road verges (Populations 1, 5, 6, 7, 8, 9, 10, 11, 12, 14 and 15). However, a number of populations also occur on a range of other associated land uses, including private farmland (Populations 9); Road Reserve land (Populations 2, 3, 4B) and a Rail Reserve (Populations 4A ). All populations along the shire, road and rail verges should be monitored for maintenance activities and close liaison maintained with the appropriate management agency. Liaison with the landowners at Population 9 should be continued on a regular basis.

### 5.5.2 Protection from grazing

Observations on Population 12 along the shire road verge adjacent to a fenceline indicate that this species is prone to sheep grazing. It is recommended that all species which occur on farmland where grazing activity is possible (Population 9) be fenced. This management action would assist in the promotion and establishment of seedlings.

### 5.5.3 Protection from accidental destruction

Population 16B is threatened by vehicular access which occurs throughout the area. The area is also being used as a dumping ground for household and industrial waste.. Populations 1, 5, 6, 7, 8, 9, 10, 11, 12, 14 and 15 occur along shire road verges and should be monitored on a regular basis to determine whether road maintenance (grading and road widening) is threatening these populations.

### 5.5.4 Protection from fire

This species appears to be highly flammable and starch grain assessment indicates it may have some resprouting qualities. Indeed, at Population 6 some plants have been recorded as reprouting at the base due to disturbance. Monitoring of the burn trial should be undertaken over the next season to ascertain whether suckering or reseeding has taken place. It is recommended that current management practice should protect this species from frequent fire.

### 5.5.5 Weed control

Invasive weeds are a major threat at Population 9. It is recommended that weed control be carried out as soon as possible. Population 10 is threatened by wind blown medic seed which is covering several shrubs up to 60 cm. Maximum height of these shrubs ranges only to 1.2 m. It is recommended that this population be monitored closely.

### 5.5.6 Linear markings

Population 10 requires road markers. Roadside markers have been located at Population 14.

### 5.5.7 *Ex situ* conservation

Although not currently a high priority seed collection from all populations and *ex situ* conservation of this species is advisable. This may be achieved through cultivation at Kings Park and Botanic Gardens and long-term seed storage in the CALM Threatened Flora Seed Centre

Currently, cuttings have been successfully raised at the Adelaide Botanic Gardens since 1976. Cuttings and grafting programs have been initiated at the Kings Park

Botanic Gardens from 1991. However, whilst the grafting strike rate was 100% (6/6), cuttings survival rate was minimal at 1% (1/78). Currently, no fruit material is available in any seed bank collections. Populations should be targeted for fruit collection in mid- December. Seed collection will not only provide an *ex situ* genetic resource for this species but will also for further research on seed longevity and autecological studies.

### 5.5.8 Rehabilitation and Recovery

No translocation or recovery actions are currently required for this species. However, if seedlings become established along the road margins (where roadside runoff is greatest as illustrated by seedling recruitment at Population 1), it is suggested that where possible these seedlings are transplanted into similar adjacent habitats away from the road

### 5.5.9 Monitoring

A monitoring site has been located at Population 13 during June 1993 where 11 plants have been recorded for ecology and germination/recruitment studies (Appendix 3). The majority of plants appear healthy. No seedlings are present, no insect damage was observed. This site should be monitored on a regular basis for autecological data. Half-yearly surveys of this site should be carried out, to determine growth habits and germination requirements in the field

# 6. *E. VERTICILLATA* CHINNOCK WHORLED EREMOPHILA

## 6.1 History, Ecology and Taxonomy

Unlike most *Eremophila* species which have leaves alternatively arranged, *E. verticillata* have leaves in whorls (Chinnock 1982). This feature only occurs in one other species (*E. ternifolia*). Low spreading shrub to 80 cm high by 1 m wide with terete, often erect branches and narrow appressed leaves. Occurs in brown powdery loam under open low eucalypt woodland (*E. longicornis, E. annulata* and *E. floctoniae* in association with *Maireana erioclada* and *Threlkeldia diffusa*; see Chinnock 1986) NW of Ravensthorpe (Hopper *et al.* 1990) along the roadside amongst fallen mallee by Lake Cobham, WA (Chinnock 1982). Flowering is October-January. Difficult to locate unless in flower. It has a strong odour (similar to *E. phillipsii*). It is known to prefer disturbed sites. The sepals are green, with a violet corolla, with the inside of tube white on lower side with purple spots. It is an entomophilous species. Fruits are dry, beaked and slightly separated into two at apex. They are bilocular with one ovule per loculus (Chinnock 1986). Adult plants probably do not last more than ten years in natural populations.

## 6.2 Distribution and Conservation Status

Five *E. verticillata* populations are known, and are as follows:

Population 1- Located on vacant crown land, SSE of Newdegate. Initial population of 60 plants in 1986. Shrubs recorded in poor condition. Current population 12 adults (7 mortalities) in 1993.

Population 2- Located on vacant crown land. Initial population of 2000+ in 1991 (635 adults & 1500 seedlings). Population has developed within topsoil in 45 x 250 m strip, that has been redistributed on old dolomite mine workings within area which consisted of *Eucalypts loxophleba, E. flocktoniae, Melaleuca thyoides* and *Dodonaea concinna* woodland. Current population of 1050+ (1000 adults and 50 seedlings, 200 mortalities counted) as of 1993.

Population 3- Located on vacant crown land 0.5 km NNW of Population 2. Initial population of 3 plants in 1980. Population unable to be located in 1986 and 1993 and is presumed extinct.

Population 4- Located on private farmland, SW of Kalgarin. Initial population of 3 plants. In February 1980 regrowth was recorded after clearing. In June 1988 area concerned had been cropped and grazed by sheep with no plants found. Population unable to be located after post-clearing 1988. Population assumed extinct.

Population 5- Located on shire road reserve East of Newdegate. Initial population not recorded in 1968. Population unable to be located in 1980 and 1987. Population presumed extinct.

Total plant number known: 1062+

### 6.3 Seed germination requirements

The fruits have been observed to be ovoid, 3.5-4.0 mm in length and 1.5-2.5 mm wide. They are beaked. The fruits are bilocular, and enclose two locules, each containing one seed (Richmond 1993). Seeds are ovoid, 1.5 mm in length, and 0.8 mm wide. Due to the fragile nature of the seeds, whole fruits were used during germination trials. The apex of the fruit was sliced prior to the germination trial to promote water and oxygen uptake, and is in accordance with the CSIRO Tree Seed Centre (Canberra) protocol for establishing woody fruits. However, no germination was recorded after 40 days. Further research is required on this species.

### 6.4 Fire Tolerance

A controlled burn was undertaken during Winter 1994 on 14 adult plants, which were in senescent condition at Population 1. The majority of shrubs within the trial were flammable. Monitoring of this burn trial should be undertaken over the next season to determine whether reprouting or reseeding has taken place. Whilst no recruitment was recorded from reseeding activity, this may be due to unfavourable rainfall patterns. A visual assessment of the relative density of starch grains within the roots of this species resulted in a visual starch rating of 6, indicating that it may posses characteristics of a resprouter.

### 6.5 Recommendations for Conservation and Management

With only two extant populations and the presumed extinction of three populations the preparation of an Interim Recovery Plan is recommended for this species.

#### 6.5.1 Liaison with landowners and shires

Both populations occur on vacant crown land. Population 2 was previously mined prior to topsoil replacement which contained the fruit source material from which this population developed. It should be noted that now extinct populations have been recorded South West of Kalgarin (Population 4) and East of Newdegate (Population 5). These areas should be monitored on a regular basis, since this species is now restricted to one main population (Population 1) which is currently in decline.

### 6.5.2 Protection from grazing

This species has been recorded as being grazed by sheep at Population 4 prior to its disappearance from that site. However, the remaining Two Populations (1 and 2) are not threatened by grazing activity.

### 6.5.3. Protection from accidental destruction

Open-cut mining activity no longer occurs at Population 1, and so no direct threat exists for either Populations 1 or 2.

### 6.5.4 Protection from fire

This species appears to be flammable, with the majority of species during the trial burn (Population 2) losing all above ground vegetative components to the fire. Population 1 was established as a reseeder species when topsoil had been redistributed on an old dolomite mine workings within an area which previously consisted of *Eucalyptus* woodland. As a result, this species may posses characteristics that lend itself to the category of reseeder. However, a visual assessment of the relative density of starch grains within the roots of this species showed a starch rating of 6, indicating that it may also possess characteristics of a resprouter. This is confirmed by the historical records at Population 4, which indicate that regrowth after cropping occurred. Monitoring of this burn trial should be undertaken over the next season to ascertain whether suckering or reseeding has taken place. It is recommended that current management protect this species from fire.

### 6.5.5 Weed control

Weeds are not currently a threat to the populations.

### 6.5.6 Linear markings

Linear markings are in place at Population 1, though they are old shire markers which are easily missed due to discolouration and should be replaced. Road markers are not required at Population 2.

### 6.5.7 *Ex situ* conservation

Seed collections from both populations and *ex situ* conservation of this species is needed. This may be achieved through cultivation at Kings Park and Botanic Gardens and long-term seed storage in the CALM Threatened Flora Seed Centre

Cuttings have been successfully raised at the Adelaide Botanic Gardens since 1978 with material obtained from Populations 1 and 2. Cuttings and grafting programs have been initiated at the Kings Park Botanic Gardens from 1991. However, whilst the grafting strike rate was 100% (6/6), cutting survival rate was minimal at 1% (1/78). Currently, no fruit material is available in any seed bank

collections. Fruit material could also be collected from the plants which have been raised at the Adelaide Botanic Gardens.

### 6.5.8 Rehabilitation and Recovery

With only two known extant populations recovery actions are recommended for this species in relation to Population 1. This population could be increased in size by obtaining some of the source topsoil from which Population 1 originated and spreading this material in an area adjacent to the present site for possible germination of soil stored seed. Close liaison with the previous lease holder should be undertaken as they were instrumental in initiating this populations and could assist in reproducing the appropriate conditions for seedling establishment.

### 6.5.9 Survey

Since this species is now restricted to two populations, further survey work is a priority. Open low eucalypt woodland (*E. longicornis, E. annulata* and *E. floctoniae* in association with *Maireana erioclada* and *Threlkeldia diffusa*) on brown powdery loam should be targeted for future surveys.

### 6.5.10 Monitoring

A monitoring site has been located at Population 1 during June 1993 where 11 plants have been recorded for ecology and germination/recruitment studies (Appendix 3). The majority of plants appear healthy. Due to the density of this population, the monitoring diameter site was only $6m^2$. No seedlings are present. No insect damage has been recorded within this monitoring site. This site should be monitored on a regular basis for autecological data.

# 7. *E. VISCIDA* ENDL. VARNISH BUSH

## 7.1 History, Ecology and Taxonomy

A large erect shrub to 6 m high (2.0-6.0 x 1.5-5.0 m, see Elliot and Jones 1984) with elliptical-lanceolate shiny green sticky leaves to 10 cm long (Hopper *et al.* 1990). Grows in a variety of soils between Mullewa and Lake Hope (Hopper *et al.* 1990). It has been recorded as being fast growing, preferring warm to hot positions and well-drained soils (Elliot and Jones 1984). Chinnock (1982) recorded its distribution as between Latham and Warrachuppin. Flowering is between September-October (Hopper *et al.* 1990). Sepals are yellow tinged metallic blue-green or pink, enlarging at fruiting stage. It is an ornithiphilous species. This species may be root suckering (Chinnock 1982). It grows on light-brown sandy and clay loams over granites or red-brown clay loams, and is associated with *Acacia* species (Chinnock 1982). Elliot and Jones (1984) have also observed it as growing in open woodland in association with *Eucalyptus loxophleba* (York Gum).

## 7.2 Distribution and Conservation Status

Eleven *E. viscida* populations are known:

Population 1- Located at Chiddarcooping Nature Reserve. Initial population of 4 plants in 1985. Unable to locate population in 1993. Further monitoring required.

Population 2- Located on private land North of Westonia. Initial population of 20 plants. In association with *E. loxophleba*, *Acacia acuminata, Melaleuca uncinate, Dodonaea inaequifolia* and *Callistemon phoeniceus*. Current population of 15 plants.

Population 3- Located on shire road reserve East of Nungarin (Muckinbudin Shire). Initial population of 1 plant. MRD Markers in place. Current population of 1 plant.

Population 4- Located on shire road verge North of Westonia. Initial population of 2 plants. Current population of 2 plants.

Population 5- Located on Shire road verge North of Westonia. Initial population of 2 plants. Current population of 2 plants.

Population 6- Located on Nature Reserve No. 16000. Initial population of 4 plants. Current population of 29 plants.

Population 7A- Shire road reserve North-West of Westonia. Initial population of 30 plants. Includes both cream and "Latham" blue-green flower forms. Current population of 27 plants.

Population 7B- Located on private farmland 10 m north of Population 7A. Initial population of 2 plants. Current population of 1 plant.

Population 7C- Shire road verge 4.3 km South of Population 7A. Initial population of 1 plant. Current Population of 1 plant.

Population 8- Located on private farmland, near Mt. Grey Lookout, SE of Mukinbudin. Initial population of 1 plants in 1992. Current Population 1 plant.

Population 9- Located on private farmland, SSW of Mukinbudin. Initial population of 1 plants in 1991. Current Population 1 plant.

Population 10- Located on shire road verge private farmland, East of Mukinbudin. Initial population of 5 plants in 1992. Population associated with *Melaleuca uncinata* community. Current Population 5 plants.

Population 11- New Population located on private farmland, North of Westonia in 1993. North side of track 450 plants. South side of track 1000+ plants, and follows creekline.

Total plant number known: 1030+.

### 7.3 Seed germination requirements

The fruits have been observed to be ovoid, 4.0-6.5 mm in length, and 3.0-3.5 mm wide. The upper half of the fruit is hirsute in nature. The fruits contain two locules, within which 2 seeds may be enclosed (Richmond 1993). The seeds are obovoid, 2.5 mm in length, and 1.0 mm wide. After 40 days, 52% (n=60) of excised *E. viscida* seeds germinated, with 13% of seeds germinating after 4 days. This confirms that once the seeds are excised from the fruits, the prerequisite restricting germination is only moisture and temperature.

### 7.4 Fire Tolerance

A controlled burn was not undertaken on this species because plant density was considered too low on the possible trial sites. However, during the course of the study, a new population in excess of 1000+ was discovered North of Westonia (Population 11). A visual assessment of the relative density of starch grains within the roots of this species resulted in a visual starch rating of 7, indicating that it may posses characteristics of a resprouter. This has been confirmed by field observations at Population 11, where suckering of disturbed root systems was evident (see also Chinnock 1982).

## 7.5 Recommendations for Conservation and Management

### 7.5.1 Liaison with landowners and shires

The majority of Populations occur on either shire road verge (Populations 3, 4, 5, 7A, 7C and 10) or private farmland (Populations 2, 7B, 8, 9 and 11). All populations along the shire road verges should be monitored for maintenance activities and close liaison maintained with the appropriate management agency. Liaison with the landowners should be maintained on a regular basis.

Liaison with the landowners at Population 11 is of particular importance because of the large population size (>1400). While land acquisition is not a viable option due to the small area concerned (<2 ha) close liaison with the landowner is important particularly in relation to possible grazing and continued monitoring.

### 7.5.2 Protection from grazing

This species is prone to sheep grazing, as recorded at Population 2. It is recommended that all populations on private land (Populations 2, 7 B, 8, 9 and 11) where grazing activity is possible, be fenced. Rabbits are considered a potential threat, and as a consequence inspection of rabbit damage should be included during population monitoring.

### 7.5.3 Protection from accidental destruction

The two main activities which threaten this species is road maintenance and farming activity. Road maintenance at Populations 3, 4, 5, 7A, 7C and 10 should be monitored on a regular basis to determine population stability. Farming practices at Populations 2, 7 B, 8, 9 and 11 should be monitored where these populations occur. The provision of access tracks and fire breaks should be regulated where they could have a direct effect on the population under consideration. For example, recent access track construction at the northern section of population 11 may affect this population, and close monitoring should be undertaken with the landowner.

### 7.5.4 Protection from fire

This species may be highly flammable, due to the resinous nature of the leaves and stems (similar to *E. resinosa*). The visual assessment of the relative density of starch grains within the roots gave a rating of 5, indicating that this species may possess some resprouter qualities. Indeed, at Population 11, some plants have been recorded as reprouting at the base due to disturbance. It is recommended that a detailed survey of Population 11 be undertaken, prior to a controlled burn being carried out at this site on a small sub-sample of the population. Where possible, current management should protect this species from frequent fire.

### 7.5.5 Weed control

Exotic weeds pose some threat to Population 4, and should be monitored and if necessary controlled.

### 7.5.6 Linear markings

Roadside markers have been located at Population 3. Roadside markers are required at Population 7A.

### 7.5.7 *Ex situ* conservation

Although not currently a high priority, seed collection from all populations and *ex situ* conservation of this species is advisable. This may be achieved through cultivation at Kings Park and Botanic Gardens and long-term seed storage in the CALM Threatened Flora Seed Centre

Currently, propagation from cuttings has been undertaken at Kings Park Botanic Gardens. Additional tips have been grafted onto *Myoporum* species root stock, which are later used as cutting material. Grafting has also been successful at the Adelaide Botanic Gardens. Currently, no fruit material is available in any seed bank collections. Populations should be initially targeted for fruit collection in mid-December. Seed collection will not only provide an *ex situ* genetic resource for this species but will also provide valuable material for further research on seed longevity and autecological studies.

### 7.5.8 Rehabilitation and recovery

No translocation or recovery actions are currently required for this species. However, if seedlings become established along the road margins (where roadside runoff is greatest), it is suggested that where possible these seedlings are transplanted into similar adjacent habitats away from the road.

### 7.5.9 Monitoring

A monitoring site has been located at Population 7A (27 plants) for ecology and germination/recruitment studies (Appendix 4). The majority of plants suffer from foliage depletion, with only 2 plants (7%) being characterised by 100% foliage cover of all branchlets. Creeper infestation affects 6 plants (22% of population), ranging between 30-50% cover. The monitoring site includes only one young juvenile shrub. It is recommended that this site be monitored on a regular basis for autecological data.

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Appendix 1. *Eremophila caerulea* subsp. *merrallii* monitoring site 30.11.94

| Plant No. | Sector | Side | Length metres | Diam metres | Height cm | Widest cm | Narrow cm | Comments | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Flowers | Condition |
| 1 | LHS | 0-45 | 1.50 | 0.90 | 170 | 43 | 22 | ~ | dead |
| 2 | LHS | 0-45 | 1.50 | 1.00 | 14 | 39 | 16 | ~ | dead |
| 3 | LHS | 0-45 | 2.20 | 1.50 | 23 | 46 | 33 | df | ~ |
| 4 | LHS | 0-45 | 2.30 | 1.30 | 32 | 60 | 40 | df | ~ |
| 5 | RHS | 0-45 | 2.60 | 0.00 | 32 | 70 | 46 | ~ | 80% def |
| 6 | LHS | 0-45 | 2.60 | 0.80 | 35 | 87 | 63 | df | ~ |
| 7 | RHS | 0-45 | 2.90 | 0.60 | 24 | 54 | 34 | df | ~ |
| 8 | LHS | 0-45 | 3.10 | 0.85 | 34 | 70 | 47 | df | 20% def |
| 9 | RHS | 0-45 | 2.54 | 0.91 | 34 | 54 | 38 | ~ | ~ |
| 10 | RHS | 0-45 | 5.65 | 1.20 | 33 | 70 | 52 | df | ~ |
| 11 | RHS | 0-45 | 5.80 | 0.95 | 34 | 65 | 33 | df | galls |
| 12 | RHS | 0-45 | 5.95 | 0.90 | 29 | 60 | 32 | df | ~ |
| 13 | RHS | 0-45 | 6.30 | 1.20 | 36 | 90 | 75 | df | ~ |
| 14 | RHS | 0-45 | 5.80 | 1.40 | 37 | 42 | 37 | df | ~ |
| 15 | RHS | 0-45 | 5.70 | 1.30 | 38 | 48 | 27 | df | ~ |
| 16 | RHS | 0-45 | 5.80 | 1.15 | 40 | 77 | 37 | df | ~ |
| 17 | LHS | 0-45 | 6.20 | 3.10 | 50 | 115 | 78 | df | 10% def |
| 18 | LHS | 0-45 | 6.25 | 3.44 | 39 | 85 | 62 | df | galls |
| 19 | LHS | 0-45 | 6.00 | 3.65 | 37 | 78 | 52 | df | 20% def |
| 20 | LHS | 0-45 | 4.40 | 0.85 | 25 | 37 | 18 | ~ | ~ |
| 21 | LHS | 0-45 | 9.90 | 2.80 | 44 | 103 | 77 | df | ~ |
| 22 | LHS | 0-45 | 9.85 | 2.30 | 17 | 42 | 28 | ~ | dead |
| 23 | LHS | 0-45 | 9.85 | 2.03 | 49 | 120 | 63 | df | ~ |
| 24 | LHS | 45-90 | 2.10 | 0.10 | 22 | 40 | 29 | df | ~ |
| 25 | LHS | 45-90 | 2.90 | 0.28 | 24 | 58 | 40 | df | ~ |
| 26 | LHS | 45-90 | 3.90 | 0.13 | 21 | 32 | 30 | ~ | dead |
| 27 | LHS | 45-90 | 3.90 | 0.18 | 33 | 72 | 60 | df | ~ |
| 28 | LHS | 45-90 | 4.40 | 1.35 | 35 | 46 | 22 | ~ | ~ |
| 29 | LHS | 45-90 | 4.50 | 1.20 | 20 | 26 | 16 | ~ | ~ |
| 30 | LHS | 45-90 | 5.30 | 0.70 | 35 | 80 | 47 | df | ~ |
| 31 | LHS | 45-90 | 5.90 | 1.65 | 32 | 80 | 45 | df | 30% def |
| 32 | LHS | 45-90 | 5.75 | 1.75 | 32 | 30 | 25 | ~ | 50% def |
| 33 | LHS | 135-180 | 2.75 | 1.20 | 26 | 60 | 49 | df | ~ |
| 34 | LHS | 90-135 | 6.90 | 1.32 | 22 | 60 | 37 | df | ~ |
| 35 | LHS | 90-135 | 7.35 | 1.54 | 34 | 60 | 48 | df | galls |
| 36 | LHS | 90-135 | 7.10 | 1.20 | 21 | 49 | 43 | df | ~ |
| 37 | RHS | 135-180 | 4.50 | 0.70 | 30 | 50 | 20 | df | ~ |
| 38 | LHS | 180-225 | 5.85 | 0.16 | 16 | 39 | 20 | ~ | ~ |
| 39 | LHS | 315-360 | 3.90 | 0.15 | 23 | 95 | 68 | df | ~ |
| 40 | RHS | 315-360 | 9.30 | 1.15 | 23 | 57 | 38 | df | ~ |
| 41 | LHS | 315-360 | 10.00 | 4.25 | 36 | 1.91 | 1.67 | df | ~ |
| 42 | LHS | 315-360 | 10.00 | 3.25 | 34 | 23 | 23 | df | ~ |
| 43 | LHS | 315-360 | 10.00 | 2.25 | 45 | 95 | 85 | df | 30% def |

Key: 30.11.94 Study site established

30.11.94: plants 01-43: study site established (yellow flags)

No: refers to plant number in monitoring plot.

Sector: Degree sector in which plant is located-sectors divided into 45 degree sectors.

Side: Location of plant, either left hand side (LHS) or right hand side (RHS).

Length: Distance along either of sector.

Diam: Distance of plant perpendicular to edge of sector.

Height: Maximum height of plant (measured from plant main stem).

Width (Widest): Widest measurement of plant (through centre).

Width (Narrow): Narrowest measurement of plant (through centre).

Comments/Flowers: presence or absence of flowers-df refers to dried flowers.

Comments/Condition: Condition status of shrub e.g. dead; insect attack e.g. insect galls or 30% def refers to percentage plant is defoliated.

Appendix 2. *Eremophila inflata* monitoring site 26.6.93

| Plant No. | Hght cm | Wi cm | Na cm | Comments | | | Plant No. | Hght cm | Wi cm | Na cm | Comments | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flowers | Condition | Insect | | | | | Flowers | Condition | Insect |
| 1 | 62 | 70 | 84 | ~ | ~ | ~ | 38 | 61 | 66 | 79 | ~ | ~ | ~ |
| 2 | 126 | 203 | 195 | ~ | ~ | scale 0.1% | 39 | 63 | 40 | 43 | ~ | ~ | ~ |
| 3 | 160 | 201 | 225 | ~ | ~ | ~ | 40 | 50 | 30 | 49 | ~ | seedling | ~ |
| 4 | 101 | 140 | 171 | ~ | ~ | ~ | 41 | 52 | 55 | 51 | ~ | seedling | ~ |
| 5 | 87 | 135 | 90 | ~ | ~ | ~ | 42 | 58 | 46 | 46 | ~ | ~ | ~ |
| 6 | 131 | 66 | 61 | ~ | ~ | ~ | 43 | 68 | 52 | 38 | ~ | ~ | ~ |
| 7 | 141 | 168 | 149 | ~ | ~ | ~ | 44 | 52 | 49 | 47 | ~ | seedling | ~ |
| 8 | 100 | 187 | 196 | ~ | ~ | ~ | 45 | 27 | 43 | 34 | ~ | ~ | ~ |
| 9 | 119 | 159 | 144 | ~ | ~ | ~ | 46 | 60 | 63 | 54 | ~ | ~ | ~ |
| 10 | 94 | 80 | 80 | ~ | seedling | scale 0.5% | 47 | 59 | 55 | 40 | ~ | 50% foliage | ~ |
| 11 | 78 | 156 | 110 | ~ | ~ | scale 0.1% | 48 | 86 | 35 | 49 | ~ | ~ | ~ |
| 12 | 130 | 128 | 130 | ~ | ~ | ~ | 49 | 80 | 50 | 76 | ~ | ~ | ~ |
| 13 | 121 | 113 | 100 | ~ | old fruits | scale 0.1% | 50 | 75 | 85 | 77 | ~ | ~ | ~ |
| 14 | 100 | 100 | 87 | ~ | ~ | ~ | 51 | 62 | 70 | 63 | ~ | ~ | ~ |
| 15 | 91 | 68 | 40 | ~ | ~ | ~ | 52 | 66 | 50 | 44 | ~ | ~ | ~ |
| 16 | 68 | 62 | 46 | ~ | ~ | ~ | 53 | 70 | 60 | 44 | ~ | ~ | ~ |
| 17 | 49 | 61 | 77 | ~ | ~ | ~ | 54 | 45 | 51 | 48 | ~ | ~ | ~ |
| 18 | 72 | 91 | 62 | ~ | ~ | ~ | 55 | 76 | 51 | 48 | ~ | ~ | ~ |
| 19 | 50 | 40 | 65 | ~ | ~ | ~ | 56 | 58 | 46 | 34 | ~ | ~ | ~ |
| 20 | 70 | 64 | 79 | ~ | ~ | ~ | 57 | 53 | 44 | 41 | ~ | ~ | ~ |
| 21 | 32 | 17 | 10 | ~ | ~ | ~ | 58 | 66 | 62 | 61 | ~ | ~ | ~ |
| 22 | 52 | 27 | 40 | ~ | ~ | ~ | 59 | 68 | 55 | 63 | ~ | ~ | ~ |
| 23 | 48 | 100 | 64 | ~ | 50% foliage | ~ | 60 | 51 | 55 | 57 | ~ | ~ | ~ |
| 24 | 72 | 71 | 75 | ~ | ~ | scale 0.1% | 61 | 72 | 73 | 76 | ~ | 2 in 1 | ~ |
| 25 | 61 | 65 | 77 | ~ | ~ | ~ | 62 | 45 | 32 | 47 | ~ | ~ | ~ |
| 26 | 64 | 98 | 93 | ~ | ~ | ~ | 63 | 51 | 33 | 28 | ~ | ~ | ~ |
| 27 | 34 | 53 | 51 | ~ | ~ | ~ | 64 | 61 | 47 | 50 | ~ | ~ | ~ |
| 28 | 47 | 49 | 47 | ~ | ~ | ~ | 65 | 23 | 16 | 13 | ~ | seedling | ~ |
| 29 | 63 | 61 | 72 | ~ | ~ | ~ | 66 | NR | NR | | ~ | ~ | ~ |
| 30 | 37 | 28 | 27 | ~ | ~ | ~ | 67 | 40 | 41 | 32 | ~ | seedling | ~ |
| 31 | 84 | 89 | 74 | ~ | ~ | ~ | 68 | 28 | 13 | 16 | ~ | 2 in 1,1 dead | ~ |
| 32 | 59 | 81 | 74 | ~ | ~ | ~ | 69 | 44 | 28 | 47 | ~ | seedling | ~ |
| 33 | 50 | 57 | 70 | ~ | ~ | ~ | 70 | 27 | 32 | 36 | ~ | seedling | ~ |
| 34 | 40 | 27 | 24 | ~ | seedling | ~ | 71 | 24 | 12 | 13 | ~ | seedling | ~ |
| 35 | 75 | 52 | 50 | ~ | ~ | ~ | 72 | 31 | 12 | 14 | ~ | seedling | ~ |
| 36 | 73 | 49 | 50 | ~ | ~ | ~ | 73 | 29 | 31 | 31 | ~ | seedling | ~ |
| 37 | 54 | 172 | 156 | ~ | 5% foliage | ~ | 74 | 74 | 83 | 71 | ~ | ~ | ~ |

Key: 26.6.93 Study site established

26.6.93: plants 01-74: study site established (metal pins)

N0: refers to plant number in monitoring plot.

Hght: Maximum height of plant (measured from plant main stem).

Wi (Widest): Widest measurement of plant (through centre).

Na (Narrow): Narrowest measurement of plant (through centre).

Comments/Flowers: presence or absence of flowers-df refers to dried flowers.

Comments/Condition: Condition status of shrub e.g. dead; growth phase i.e. seedling;

in and 21 refers to number of seedlings per fruit.

Comments/Insects: percentage scale insect attack

NB: Plant tag number 66 was not utilised witnin study site due to re-identification of plant (ie not an Eremophila).

Appendix 3. *Eremophila nivea* monitoring site 13.6.93

| Plant No. | Sector | Side | Length metres | Diam metres | Height cm | Widest cm | Narrow cm | Comments | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Flowers | Condition |
| 1 | RHS | 0-30 | 5.20 | 0.55 | 8.9 | 7.5 | 6.0 | ~ | seedling |
| 2 | LHS | 30-60 | 8.70 | 0.80 | 14.0 | 8.5 | 5.5 | ~ | seedling |
| 3 | LHS | 60-90 | 9.60 | 2.50 | 63.0 | 14.5 | 11.5 | ~ | ~ |
| 4 | RHS | 90-120 | 2.40 | 0.75 | 96.0 | 101.0 | 87.0 | ~ | ~ |
| 5 | RHS | 90-120 | 4.20 | 1.15 | 122.0 | 42.0 | 70.0 | ~ | ~ |
| 6 | LHS | 90-120 | 4.05 | 1.55 | 58.0 | 13.0 | 13.0 | ~ | ~ |
| 7 | LHS | 90-120 | 4.20 | 1.35 | 30.5 | 11.0 | 8.5 | ~ | ~ |
| 8 | RHS | 90-120 | 4.00 | 0.90 | 77.0 | 30.5 | 25.0 | ~ | ~ |
| 9 | RHS | 90-120 | 4.15 | 0.75 | 67.5 | 24.0 | 22.0 | ~ | ~ |
| 10 | RHS | 90-120 | 4.15 | 0.65 | 96.0 | 22.0 | 20.0 | ~ | ~ |
| 11 | RHS | 90-120 | 4.45 | 0.75 | 63.0 | 32.0 | 18.0 | ~ | ~ |
| 12 | RHS | 90-120 | 4.60 | 0.20 | 136.0 | 220.0 | 131.0 | ~ | ~ |
| 13 | RHS | 90-120 | 4.35 | 0.00 | 100.0 | 47.0 | 60.0 | ~ | 10% foliage/prost |
| 14 | LHS | 90-120 | 4.85 | 0.75 | 92.0 | 44.0 | 53.0 | ~ | ~ |
| 15 | LHS | 90-120 | 5.05 | 0.90 | 57.5 | 13.0 | 17.0 | ~ | ~ |
| 16 | RHS | 90-120 | 6.25 | 0.72 | 24.0 | 7.5 | 7.5 | ~ | 2 in 1,seedling |
| 17 | RHS | 90-120 | 6.30 | 1.65 | 92.5 | 100.0 | 98.0 | ~ | ~ |
| 18 | RHS | 90-120 | 6.50 | 1.62 | 168.0 | 92.0 | 67.0 | ~ | ~ |
| 19 | RHS | 90-120 | 6.50 | 1.80 | 146.0 | 84.0 | 53.0 | ~ | ~ |
| 20 | LHS | 90-120 | 6.40 | 1.82 | 97.5 | 71.0 | 38.0 | ~ | ~ |
| 21 | RHS | 120-150 | 3.00 | 0.38 | 8.0 | 3.5 | 2.5 | ~ | seedling |
| 22 | RHS | 120-150 | 3.40 | 0.60 | 76.0 | 43.0 | 41.0 | ~ | ~ |
| 23 | RHS | 120-150 | 3.80 | 1.13 | 22.5 | 6.5 | 5.0 | ~ | seedling |
| 24 | RHS | 120-150 | 3.75 | 1.27 | 4.0 | 1.0 | 1.5 | ~ | sedling |
| 25 | RHS | 120-150 | 4.20 | 1.40 | 41.5 | 8.5 | 11.0 | ~ | 2 in 1 |
| 26 | LHS | 120-150 | 4.05 | 0.00 | 83.0 | 28.0 | 26.0 | ~ | ~ |
| 27 | LHS | 120-150 | 5.45 | 0.65 | 13.0 | 4.5 | 3.5 | ~ | seedling |
| 28 | LHS | 120-150 | 5.30 | 1.26 | 65.0 | 52.0 | 42.0 | ~ | ~ |
| 29 | RHS | 120-150 | 5.40 | 1.37 | 54.0 | 32.5 | 31.0 | ~ | ~ |
| 30 | RHS | 120-150 | 4.25 | 0.85 | 97.0 | 50.5 | 44.0 | ~ | ~ |
| 31 | LHS | 150-180 | 4.00 | 0.25 | 108.5 | 75.5 | 80.0 | ~ | ~ |
| 32 | LHS | 180-210 | 6.75 | 1.20 | 14.5 | 5.0 | 5.5 | ~ | seedling |
| | | 210-240 | NA | | | | | ~ | ~ |
| 33 | RHS | 240-270 | 2.05 | 0.35 | 8.0 | 3.0 | 3.5 | ~ | seedling |
| 34 | RHS | 240-270 | 2.30 | 0.40 | 15.0 | 7.0 | 6.5 | ~ | seedling |
| 35 | RHS | 240-270 | 2.35 | 0.30 | 36.0 | 19.0 | 13.0 | ~ | ~ |
| 36 | RHS | 270-300 | 1.60 | 0.24 | 13.0 | 6.0 | 6.0 | ~ | seedling |
| 37 | RHS | 270-300 | 1.80 | 0.18 | 15.0 | 8.0 | 6.5 | ~ | seedling |
| 38 | RHS | 270-300 | 1.90 | 0.13 | 8.0 | 5.0 | 3.0 | ~ | seedling |
| 39 | LHS | 270-300 | 4.00 | 0.12 | 20.0 | 7.0 | 7.5 | ~ | seedling |
| 40 | LHS | 300-330 | 1.80 | 0.00 | 3.5 | 2.5 | 1.5 | ~ | seedling |
| 41 | RHS | 300-330 | 2.75 | 0.30 | 17.0 | 7.0 | 6.0 | ~ | ~ |
| 42 | RHS | 300-330 | 2.85 | 0.25 | 20.0 | 6.0 | 5.5 | ~ | ~ |
| 43 | RHS | 300-330 | 3.40 | 0.10 | 20.5 | 5.0 | 6.0 | ~ | ~ |
| 44 | LHS | 300-330 | 8.10 | 0.66 | 13.0 | 5.0 | 4.5 | ~ | seedling |
| 45 | RHS | 330-360 | 1.45 | 0.27 | 13.0 | 3.5 | 3.0 | ~ | seedling |
| 46 | RHS | 330-360 | 1.50 | 0.30 | 19.0 | 5.0 | 6.5 | ~ | seedling |
| 47 | LHS | 330-360 | 3.75 | 0.25 | 41.0 | 9.5 | 11.0 | ~ | seedling |

Key: 13.6.93 Study site established

13.6.93: plants 01-47: study site established (red flags)

N0: refers to plant number in monitoring plot.

Sector: Degree sector in which plant is located-sectors divided into 30 degree sectors.

Side: Location of plant, either left hand side (LHS) or right hand side (RHS).

Length: Distance along either of sector.

Diam: Distance of plant perpendicular to edge of sector.

Height: Maximum height of plant (measured from plant main stem).

Width (Widest): Widest measurement of plant (through centre).

Width (Narrow): Narrowest measurement of plant (through centre).

Comments/Flowers: presence or absence of flowers-df refers to dried flowers.

Comments/Condition: Condition status of shrub e.g. dead; or

30% def refers to percentage plant is defoliated, 2 in 1 refers to 2 sedlings from 1 fruit.

Note: Plant No.13 is prostrate and senescing, plant No.14's growth is restricted by Prickly bush.

Appendix 4. *Eremophila resinosa* monitoring site 25.6.93

| Plant No. | Sector | Side | Length metres | Diam metres | Height cm | Widest cm | Narrow cm | Comments | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Flowers | Condition |
| 1 | RHS | 0-45 | 1.00 | 0.35 | 40.0 | 43.0 | 28.5 | ~ | ~ |
| 2 | LHS | 0-45 | 2.70 | 0.90 | 29.0 | 61.0 | 55.0 | ~ | ~ |
| 3 | RHS | 0-45 | 5.20 | 2.90 | 41.0 | 39.0 | 58.0 | ~ | ~ |
| 4 | LHS | 45-90 | 6.40 | 1.30 | 21.0 | 27.0 | 47.0 | ~ | ~ |
| 5 | LHS | 45-90 | 6.15 | 1.30 | 51.0 | 46.0 | 61.0 | ~ | ~ |
| ~ | ~ | 90-125 | NA | NA | NA | NA | NA | ~ | ~ |
| ~ | ~ | 135-180 | NA | NA | NA | NA | NA | ~ | ~ |
| ~ | ~ | 180-225 | NA | NA | NA | NA | NA | ~ | ~ |
| 6 | LHS | 225-270 | 1.10 | 0.50 | 31.0 | 50.0 | 68.0 | ~ | ~ |
| 7 | LHS | 225-270 | 1.10 | 0.90 | 41.0 | 49.0 | 65.0 | ~ | ~ |
| 8 | LHS | 225-270 | 3.00 | 1.50 | 21.0 | 23.0 | 20.0 | ~ | ~ |
| 9 | LHS | 225-270 | 3.10 | 1.40 | 42.0 | 24.0 | 27.0 | ~ | ~ |
| 10 | LHS | 225-270 | 3.30 | 1.85 | 31.0 | 25.0 | 48.0 | ~ | ~ |
| 11 | LHS | 225-270 | 5.20 | 1.25 | 29.0 | 31.0 | 26.0 | ~ | ~ |

Key: 25.6.93 Study site established

25.6.93: plants 01-11: study site established (yellow flags)

No: refers to plant number in monitoring plot.

Sector: Degree sector in which plant is located-sectors divided into 30 degree sectors.

Side: Location of plant, either left hand side (LHS) or right hand side (RHS).

Length: Distance along either of sector.

Diam: Distance of plant perpendicular to edge of sector.

Height: Maximum height of plant (measured from plant main stem).

Width (Widest): Widest measurement (north-south)of plant (through centre).

Width (Narrow): Narrowest measurement (east-west) of plant (through centre).

Comments/Flowers: presence or absence of flowers-df refers to dried flowers.

Comments/Condition: Condition status of shrub e.g. dead.

30% def refers to percentage plant is defoliated, 2 in 1 refers to 2 sedlings from 1 fruit.

NA refers to not applicable (data not available).

Note: Study plot diameter is 20m.

Appendix 5. *Eremophila verticillata* monitoring site 27.6.93

| Plant No. | Sector | Side | Length metres | Diam metres | Height cm | Widest cm | Narrow cm | Comments | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Flowers | Condition |
| 1 | LHS | 45-90 | 1.50 | 0.60 | 67.5 | 161.0 | 160.0 | ~ | ~ |
| 2 | LHS | 90-135 | 2.30 | 0.30 | 78.0 | 125.0 | 95.5 | ~ | rf |
| 3 | LHS | 90-135 | 3.80 | 0.60 | 68 | 78.5 | 65 | ~ | rf |
| 4 | LHS | 90-135 | 5.00 | 0.20 | 37.0 | 45.0 | 53.0 | ~ | ~ |
| 5 | RHS | 90-135 | 3.20 | 0.50 | 91.0 | 117.5 | 90.0 | ~ | ~ |
| 6 | RHS | 90-135 | 2.80 | 0.40 | 84.5 | 89.0 | 88.0 | ~ | gf/rf |
| 7 | RHS | 90-135 | 3.60 | 0.25 | 80.0 | 83.0 | 68.0 | ~ | gf |
| 8 | LHS | 135-180 | 2.30 | 1.00 | 58.0 | 52.5 | 63.5 | ~ | 95% foliage |
| 9 | LHS | 135-180 | 3.00 | 0.95 | 82.0 | 42.0 | 61.0 | ~ | gf/rf |
| 10 | LHS | 135-180 | 4.50 | 0.25 | 74.0 | 91.0 | 84.0 | ~ | gf/rf |
| 11 | LHS | 135-180 | 4.80 | 0.95 | 65.0 | 33.0 | 30.0 | ~ | ~ |
| 12 | LHS | 45-90 | 4.30 | 0.35 | 77.5 | 122 | 95 | ~ | ~ |
| 13 | LHS | 135-180 | 3.50 | 1.60 | 61.0 | 71.0 | 52.5 | ~ | gf |
| 14 | LHS | 135-180 | 3.20 | 1.45 | 51.0 | 64.0 | 74.0 | ~ | ~ |
| 15 | RHS | 135-180 | 3.00 | 0.20 | 72.5 | 74.0 | 86.0 | ~ | gf/rf |
| 16 | RHS | 180-225 | 3.80 | 0.30 | 72.5 | 120.0 | 115.0 | ~ | ~ |
| 17 | LHS | 180-225 | 2.40 | 0.90 | 27.0 | 18.0 | 16.0 | ~ | seedling |
| 18 | LHS | 180-225 | 2.20 | 0.65 | 55.0 | 112.0 | 117.5 | ~ | gf/rf |
| 19 | LHS | 180-225 | 1.65 | 0.37 | 26.0 | 24.5 | 22.0 | ~ | seedling |
| 20 | LHS | 225-270 | 1.50 | 0.40 | 87.0 | 165.0 | 177.5 | ~ | ~ |
| 21 | RHS | 270-315 | 3.80 | 0.75 | 47 | 23 | 22 | ~ | gf/rf;seedling |
| 22 | RHS | 315-360 | 5.00 | 0.90 | 87.5 | 115 | 122 | ~ | gf/rf |
| 23 | LHS | 90-135 | 5.00 | 0.45 | 27.0 | 49.0 | 37.0 | ~ | 15% foliage |

Key: 27.6.93 Study site established

27.6.93: plants 01-23: study site established

No: refers to plant number in monitoring plot.

Sector: Degree sector in which plant is located-sectors divided into 30 degree sectors.

Side: Location of plant, either left hand side (LHS) or right hand side (RHS).

Length: Distance along either of sector.

Diam: Distance of plant perpendicular to edge of sector.

Width (Widest): Widest measurement of plant (through centre).

Width (Narrow): Narrowest measurement of plant (through centre).

Comments/Flowers: presence or absence of flowers-df refers to dried flowers.

Comments/Condition: Condition status of shrub e.g. dead; gf/rf are green and ripe fruits respectively; or

30% def refers to percentage plant is defoliated, 2 in 1 refers to 2 sedlings from 1 fruit.

Note: Plant No.23 measurements only taken from green growth.

Appendix 6. *Eremophila viscida* monitoring site 24.6.93

| Plant No. | Side of Track | Height cm | Foliage Cover (%) | Comments | |
|---|---|---|---|---|---|
| | | | | Fruits | Condition |
| 1 | RHS | 59.0 | 50 | ~ | ~ |
| 2 | RHS | 211.0 | 20 | ~ | ~ |
| 3 | RHS | 248.0 | 25 | ~ | ~ |
| 4 | RHS | 265.0 | 30 | ~ | ~ |
| 5 | RHS | 199.0 | 40 | ~ | ~ |
| 6 | RHS | 245.0 | 30 | ~ | ~ |
| 7 | RHS | 141.0 | 50 | ~ | 30% creep |
| 8 | RHS | 203.0 | 25 | ~ | ~ |
| 9 | RHS | 188.0 | 80 | ~ | ~ |
| 10 | RHS | 197.0 | 30 | ~ | ~ |
| 11 | RHS | 223.0 | 40 | ~ | ~ |
| 12 | RHS | 119.0 | 90 | ~ | ~ |
| 13 | RHS | 231.0 | 90 | ~ | ~ |
| 14 | RHS | 121.0 | 30 | ~ | prostrate |
| 15 | RHS | 143.0 | 100 | ~ | ~ |
| 16 | RHS | 191.0 | 80 | ~ | ~ |
| 17 | RHS | 63.0 | 40 | ~ | ~ |
| 18 | RHS | 146.0 | 80 | ~ | ~ |
| 19 | RHS | 327.0 | 100 | ~ | ~ |
| 20 | RHS | 31.0 | 100 | ~ | prostrate # |
| 21 | RHS | 177.0 | 85 | ~ | ~ |
| 22 | RHS | 193.0 | 80 | ~ | ~ |
| 23 | RHS | 280.0 | 80 | ~ | 50% creep* |
| 24 | RHS | 271.0 | 15 | ~ | 90% creep |
| 25 | LHS | 201.0 | 90 | ~ | 30% creep |
| 26 | LHS | 232.0 | 80 | rf | 5% creep |
| 27 | LHS | 189.0 | 95 | ~ | ~ |

Key: 24.6.93 Study site established

24.6.93: plants 01-27: study site established

No: refers to plant number in monitoring plot.

Side of track: Location of plant, either left hand side (LHS) or right hand side (RHS) when facing West along track.

Height: Maximum height of plant (measured from plant main stem).

Foliage Cover refers to percentage foliage cover of shrub.

Comments/Fruits: presence or absence of flowers-df/rf refers to dried ripe/fruits.

Comments/Condition: Condition status of shrub e.g % cover by creeper *Cassaytha nodiflora*; or form e.g. prostrate.

Note: Plant No.20 (#) is reshooting from base (suckering).

Plant No.24 (*) has main broken branch which has 50% creeper cover.

A further 5 plants at this site are dead.

Plant width (widest/narrowest) were not recorded due to the dense foliage and size of these small trees.