RECOVERY PLAN FOR THE WONGAN CACTUS

(*DAVIESIA EUPHORBIOIDES* Benth.)

by

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SUMMARY

Current species status: Gazetted as Endangered Flora under Section 23F of the Western Australian Wildlife Conservation Act (1950) on 13 March 1982. In total, 469 plants of Daviesia euphorbioides from 11 populations have been recorded in past 10 years, however only 207 (44.1%) plants of these were alive in September 1993. D. euphorbioides occurs in a few remnant populations, most of these occurring on disturbed, narrow road and rail reserves in the central wheatbelt. Careful management of the populations is essential to ensure the species continued survival in the wild.

Habitat requirements and limiting factors: Most of the range of Daviesia euphorbioides has been cleared, however there may be further populations particularly on privately owned farmland remnants and vegetated reserves within its range.

Recovery Objective: Ensure the species survival in the wild by protecting existing populations, promoting rehabilitation through population and habitat enhancement, and establishing new populations in conservation reserves.

Recovery Criteria:
2 years - revesting of land adjoining populations 1A, 1B, 2 and 3 at Wongan Hills. Collect and store seed from all populations. Search for additional populations on farmland.

5 years - rehabilitate and replant with D. euphorbioides gravel/sand pits adjoining Populations 1A and 1B. Populations of 100+ plants each to be established in conservation reserves from stands 2/3, 5/8 and 7. Complete research into flowering and seed biology and population genetics.

10 years - Self maintaining populations established or protected in conservation reserves. All known populations will be stable or increasing. Collect seed from all populations in long term storage. Representative sample of plants from each population maintained in cultivation.

Actions Needed
1. Establish a recovery team
2. Acquisition of a Conservation Reserve near Wongan Hills
3. Search for additional populations
4. Protection of habitat
5. Population and habitat enhancement
6. Research
7. Liaison and public education
8. Ex situ conservation

Bio diversity benefits: Thirteen other threatened endemic plants occur in the Wongan Hills area. Creating the proposed Nature Reserve will provide protection for Daviesia euphorbioides, eight other species of Declared Rare Flora and three priority taxa which are endemic to this area and considered at risk.

PART 1: BACKGROUND

On 13 March 1982 Daviesia euphorbioides, the Wongan Cactus, was gazetted as Endangered Flora under Section 23F of the Western Australian Wildlife Conservation Act 1950-79 (Patrick and Hopper 1982). It was ranked by the Department of Conservation and Land Management (CALM) in the 50 most threatened flora taxa in Western Australia (CALM 1992). Briggs and Leigh (1988) list Daviesia euphorbioides as vulnerable, with a geographical range less than 100 km (2V).

This recovery plan summarises the existing information about Daviesia euphorbioides and identifies actions that will ensure the species persists in the wild.

1.1 Description and Taxonomy

Daviesia is a genus of harsh shrubs with usually prickly leaves, small yellow and red pea flowers and distinctive triangular pods. The genus of 115 species is entirely restricted to Australia, with the greatest concentration (84 species) in south western Australia. The Western Australian wheatbelt is especially rich with half of the genus (56 species) confined to that region, of which about two thirds (35 species) are considered to be rare or threatened. This represents 70% of rare or threatened species in the genus.

Daviesia euphorbioides or Wongan Cactus is a distinctive shrub to 80 cm with erect, cylindrical, very thick (1 cm diameter) branches with a pithy texture inside and leaves are replaced by small prickly conical scales (Bentham 1864). The red and yellow pea flowers arise from the axils of scales in May-September and the distinctive triangular pods mature quickly and open when ripe in early summer to release 1-2 seeds per pod.

1.2 Distribution

Daviesia euphorbioides is endemic to the Western Australian wheatbelt, from Wongan Hills east to Moonijin and south of Dowerin covering a geographic range of 85 km (Figure 1). Mollemans *et al.* (1993) recorded 170 live plants from ten populations which were restricted principally to narrow road and railway reserves (Figure 2). Only a single population was located on a conservation reserve.

In total, 469 plants of Daviesia euphorbioides from 11 populations have been recorded, however only 207 (44.1%) plants were alive in 1993 (Brown, in preparation).

Four of the five larger populations were located within a 1km of one another near Wongan Hills (1A, 1B, 2 and 3). These Wongan Hills populations include 85.5% (401) of all plants recorded and 88% (180) of the live plants recorded from the September 1993 survey. All adjoined substantial areas of remnant native vegetation.

Six of the remaining populations had a single live plant in September 1993. All six populations are on narrow road and railway track verges which are dominated by introduced grasses and broadleaf weeds.

The only other population of some size was Population 7 located near Dowerin, which occurs on the verges of a narrow road reserve. Very few other native species remain at this site.

1.3 Population Summary

The locations, estimated size and condition of the populations are summarised below. Precise locality details are contained on Departmental rare flora files and databases.

1.3.1 Populations known in 1980

Rye (1980) recorded only three populations (1A, 2 and 3), all at Wongan Hills, and estimated a total of 90-100 plants, of which at least 14 were seedlings. Details on the locality, habitat and population data were given for the three populations.

Population 1A: Rye (1980) recorded 36 live plants, which included at least four seedlings, and six dead plants. The plants occurred along-side a sealed road north-west of Wongan Hills townsite, were the verge was cleared some years before when an underground telephone cable was laid. In 1989, P.H. Brown and District Wildlife Officer (DWO) Coughran recorded 11 live mature plants, 7 seedlings and 17 dead plants. Several plants were within an old, shallow gravel pit at the site. In 1993 no additional plants were recorded and a further eight plants had died.

Population 2: Rye (1980) recorded 12 mature plants, 7 seedlings and at least 19 dead plants on both sides of the railway line north west of Wongan Hills townsite. The plants occurred only were the site had been cleared along the boundaries of the railway line and a track running parallel to the track and not in the adjoining uncleared bushland. In 1989, P.H. Brown and DWO Coughran recorded 35 live and 48 dead plants. A further 19 plants died between 1989 and 1993 and 9 were graded out during railway line maintenance operations in September 1990. A total of 70 seedlings established after the soil disturbance of 1990. However, in May 1993 during Westrail railway line resleepering operations 40 (75%) of the 1990 seedling cohort were damaged, including 16 seedlings being killed out right.

Population 3: Rye (1980) recorded 29 mature plants, 3 seedlings and no dead plants on the Railway Reserve some 300 m east of Population 2. In 1989, P.H. Brown and DWO Coughran recorded 56 live and 27 dead plants. A further 9 plants died between 1989 and 1993 and 16 were graded out during railway line maintenance operations in September 1990. A total of 94 seedlings established after the soil disturbance of 1990. However, in May 1993 during Westrail railway line resleepering operations 53 (58%) of the 1990 seedling cohort were damaged, including 21 seedlings being killed out right. A further two mature plants were killed during these operations.

1.3.2 Populations Discovered 1980-1992

Since the report by Rye (1980) eight more populations have been located (Figure 2). The following summaries are compiled from CALM file records, research by Brown (in preparation) and interviews of local residence.

Population 1B - Early records for this site are not available in Departmental files. In 1989, P.H. Brown and DWO Coughran reported 23 live mature, 13 live seedlings and 4 dead plants on a Nature Reserve north-east of Wongan Hills townsite. The plants were within an area that had been disturbed during gravel exploration and associated track establishment. A further 6 seedlings established and 23 plants dead between 1989 and 1993 (Brown in preparation).

Population 4: M.D. Crisp lodged a specimen of Daviesia euphorbioides with the W.A. Herbarium (PERTH 01055291) from the Railway Reserve at Moonjin with a collection date July 1980. He recorded it as "rare (ca 6 plants)". In 1983, DWO Phil Roberts located and photographed two plants on the cleared railway reserve on the western side of the line at Moonijin. In 1989, Reserves Officer John Carter could only locate a single plant on the eastern side of the railway line. It would appear that the original plants had been removed at some time between 1983 and 1989.

Population 5: In 1985, a farmer, Mr Horace Schell, notified the local Agricultural Protection Board Officer Mike Clark of plants of Daviesia euphorbioides on the road side outside his property. DWO Roberts reported and photographed nine live plants. Mr Schell said "in his younger days the plants were plentiful and had noticed they died naturally after a few years". This appears to have occurred at the site since 1985, with five plants alive in 1987-1989 and two in 1991-1992. In 1993 only a single plant remains alive at this site and it is very large, over mature and had 10% of its crown still alive.

Population 6: In 1981, a local botanist Mr Bazil Smith located four plants on the road side at Manmanning. DWO Roberts reported three plants on the north verge and one very large plant on south verge. In 1989, P.H. Brown could only locate one live plant on the northern verge and the remains of a dead plant on the southern verge. The remaining plant had only 25% of its crown alive in 1993 and was surrounded by introduced grasses and broadleaf weeds.

Population 7: In 1985 Mr Bazil Smith located further plants on a road side south of Dowerin. DWO Roberts reported 56 live plants, with 45 on the east verge and 11 on the west verge. He indicated that the plants ranged "from small seedlings 15 cm tall to 0.5 m tall". In 1989, Brown (in press) recorded 38 live and 6 dead mature plants, with 38 plants on the east verge and 6 on the west verge. A further 17 of these dead between 1989 and 1993. A single seedling established in 1990 but was graded out in 1992.

Population 8: In 1987, DWO Roberts reported two plants (some 200 m apart) on a narrow, weed infected road verge 2 km south of Population 5. In 1989, P.H. Brown and DWO Coughran could only locate a single plant on the southern verge. This plant

was featured in a photograph by Hussey (1987) which also showed a dead seedling some 2 m away.

A local farmer, Mr Robert Boase (personal communication), first noticed the remaining plant in about 1983 when it was about 30 cm high. A seedling close by was later graded out and a third plant several hundred metres along the road died several years later. Interestingly Mr Boase remembers a plant at the same spot as the third plant above, in about 1958 while walking to school.

Population 9: In 1987, DWO Roberts reported two plants on the verge of a main road north of Wongan Hills. One plant had died by 1989 and the second appeared healthy in 1993.

Population 10: In 1987, Department of Agriculture Officer Sandra Lloyd notified CALM of several plants to the north west of Goomalling. DWO Coughran surveyed the site and reported two live plants and one large dead plant on the road verge. However, this report was filed under records for Population 5 until 1992 when it was "rediscovered" by APB Officer Lisa Stuart. Only a single plant remains on the road verge in 1993.

1.4 Habitat and Associated Species

A detailed floristic survey and vegetation mapping has been completed over the whole Wangan Hills area (Coates 1988; Coates 1992).

The Declared Rare species Hemigenia vascida has been located within the Wongan Hills Daviesia euphorbioides Populations 1A, 1B, 2 and 3. Plants of the Declared species Acacia semicircinalis and Daviesia spiralis are located on the road verge adjoining Daviesia euphorbioides Population 1A. Numerous other threatened taxa and Wongan Hills endemics occur in the facinity of the four Wongan Hills Daviesia euphorbioides populations.

1.5 Life History and Ecology

A major study of the ecology and population dynamics of Daviesia euphorbioides was carried out over the period 1989-1993 by Brown (in preparation). The study aimed to:

- To determine what type of soil disturbance events trigger regeneration of Daviesia euphorbioides.
- To record the current population structure of Daviesia euphorbioides in all known wild populations.
- To accurately determine length of life cycle, recruitment rate and loss of plants over time.

The following sections summarise the work and field observations by Brown (in preparation). All data comes from this source unless other wise stated.

1.5.1 Soil disturbance and fire

Brown (in preparation) found all populations and plants of Daviesia euphorbioides surveyed had germinated and established on sites which had been mechanically disturbed or, in one small area, burnt. Except for the latter, all plants have grown on areas cleared and shallow graded, which removed some of the top soil. Three types of mechanical disturbance were identified:

Road edge - Plants or parts of populations on the very edge of tracks and roads, which were graded regularly. Each grading could be a threat to existing plants by physical removal and a potential stimulus for regeneration. Therefore, road edge plants would be expected to represent a cohort (or cohorts) of various ages, which may be different to the cohort represented by the bulk of the population.

Road edge plants were identified in six of the 11 populations, however, four of the populations they constituted only 1-3 plants. In Population 3, some 17 plants were designated as roadside plants, four were young seedlings, one a well advanced seedling and 12 were over-mature. They appear to represent atleast 5 separate establishment events (cohorts) which appear to have regenerated at a different time than the bulk of the population.

Verge Clearing - In a number of sites the whole road or rail reserve was cleared and graded, with most plants germinating off the immediate road edge and not effected by routine grading operations. Although, some of the edge plants may be graded out subsequent, the bulk of the population can be left undisturbed for many years.

The bulk of plants in all populations (except populations 1B, 8 and 10) were found associated with this disturbance type.

Gravel extraction - In population 1A and 1B, Daviesia euphorbioides has been located in areas disturbed by surface exploration for gravel or on the edge of pits where the surface sand has been scraped away and the gravel sub surface disturbed. Daviesia euphorbioides has not been located in adjoining deep, permanent gravel or sand pits were material was extracted to some depth. This was in contrast with Daviesia spiralis, another gazetted rare Wongan endemic, which has large populations located within major gravel pits (Mollemans *et al.* 1993).

Fire - The only record of fire effecting Daviesia euphorbioides, was by Rye (1980, pp118) in a photograph dated October 1980, showing a number of seedlings regenerating beside the burnt stump of an older plant in Population 2. Rye (1980) estimated "that a fire had been through, probably last summer (1979-80) or the previous summer (1978-79)."

Results confirm **Daviesia euphorbioides** is a disturbance opportunist that regenerates from seed after fire or soil disturbance.

1.5.2 Population structure and dynamics

An estimated 305 plants were present at the time of the 1989 survey, of which approximately two thirds (190 or 62.3%) of plants were recorded as being alive (Brown in preparation). Between 1989 and 1993 71 plants died and 28 were removed or killed, leaving only 91 (29.8%) of the 1989 cohort still alive in 1993. This represents a 52.1% loss, in just three years, of the 190 plants recorded as alive in 1989.

Many of the known populations are senescent. All populations continue to be under extreme threat from physical removal by mans activities.

1.5.3 Recruitment

On 18 September 1990, the two largest populations (2 and 3) were damaged during maintenance of the vehicle access track adjacent to the railway line. Between 30%-40% of the 50m wide rail reserve was recleared and graded. This single disturbance event in September 1990 resulted in the regeneration of a total of 157 seedlings into Populations 2 and 3 over the next three years. Although several of the "seedlings" were believed to be resprouts from the original plants, the bulk of seedlings established from soil stored seed.

Early survival of seedlings (96.4%) was extremely good, with only 5 deaths recorded by September 1992. However, in May 1993 these two populations were again damaged during railway line re-sleepering operations. Of the 1990 cohort a total of 93 (65%) of seedlings were damaged, of which 37 (26%) were killed outright. A further 10 mature plants of the 1989 cohort were also damaged, with two being killed.

The continuing threat of human interference, particularly by Westrail, remains at this site.

Outside of the newly disturbed track through Populations 2 and 3, a total of just 13 seedlings established within three of the ten populations. Approximately half were road edge plants (3 from 1B; 3 from 3; 1 from 7 which was subsequent graded out).

1.6 Breeding Systems

1.6.1 Flowering and seed biology

No detailed flowering and seed biology, nor seed production, studies have been undertaken.

Our observations indicate Daviesia euphorbioides flowers between April and September, a much earlier start than recorded previously by Rye (1980) or Patrick and Hopper (1982). The start and duration of flowering may vary between years and sites. Plants often flower profusely with some tens to hundreds of flowers per plant.

Fruits have been recorded from September to November by Rye (1980), with all pods dehisced by January. In September 1992 and 1993, 105 (41%) and 120 (58%) respectively of all live plants were carrying pods, although the stage of maturity of pods appeared to vary between plants and populations (Brown, personal communication). Rye (1980) states that Daviesia euphorbioides has only two ovules per flower so that the maximum seed set possible is two seeds/pod. In a sample of 20 pods from 4 or 5 plants, the average seed set was 0.7 seeds/pod. Two of the pods had two seeds. Rye (1980) records each plant had "few to approximately 50 fruits" each.

1.7 Threats and Impacts

1.7.1 Agricultural clearing of habitat

The Western Australian wheatbelt has been extensively cleared for agriculture. This clearing has occurred selectively, leaving vegetation on areas of non-arable land (eg rocky or wetland areas), in very small pockets within agricultural lands or along narrow road and rail reserves. Remnants have been cleared for a range of other purposes, such as gravel pits, roads, tracks and buildings. They are also being indirectly cleared through grazing by domestic stock and rabbits, fire and environmental changes such as salinity.

Clearing of remnant vegetation continues to threaten plant communities and species throughout the south western Australia.

1.7.2 Maintenance and construction operations

All populations (except Population 1B which is within a Nature Reserve) occur along linear road and rail reserves which also include above and below ground utilities, such as powerlines, water pipelines and Telecom lines. In all such situations plants are vulnerable to damage or destruction by maintenance and construction operations. Indirect effects of agriculture such as clearing for fence replacement, fertilisers, weeds, trampling by moving sheep and sprays are also a factor for Populations 4, 5, 6, 7, 8 and 9.

Sixty eight plants were removed or killed through direct human activity associated with maintenance and construction operations between 1989 and 1993. The clearing and grading of access tracks along the railway line in 1990 through Populations 2 and 3 physically removed 24 live plants. In May 1993 these two populations were again damaged during railway line re-sleepering operations. A total of 93 (65%) of seedlings were damaged, of which 37 (26%) were killed outright, and 10 mature plants of the 1989 cohort were also damaged, with two being killed.

In addition, a plant died from roadside spraying (1A), two plants in the middle of the track surface were repeatedly run over and destroyed by vehicles (1B) and a "road edge" plant was removed during maintenance grading (3 and 7).

1.7.3 Fire

Fire is a major factor through out the range of Daviesia euphorbioides, due to the Mediterranean climate, with its long, dry summers. The limited information on fire effects on the Wongan Cactus by Rye (1980), indicate existing plants are killed by fire and fire can stimulate seed germination. However due to the rarity of the species, fire should be excluded from all populations.

A major threat to Daviesia euphorbioides from fire is if the four large Wongan populations (1A, 1B, 2 and 3) are burnt at the one time. They are within 1 km of one another and are linked by continuous bushland. If any of the other smaller populations are burnt in isolation this should not threaten the species.

1.7.4 Dieback disease (Phytophthora spp)

The impact of Phytophthora species on Daviesia euphorbioides is not known, however they are known to kill other species of Daviesia and many other Kwongan (heath land) plant species. Several Phytophthora species have been isolated from sites in the northern sand plains region to the east of Wongan Hills. Although dieback disease has not been recorded within the range of Daviesia euphorbioides it may threaten this species and its habitat in the future, particularly at Wongan Hills.

1.8 Existing Conservation Measures

1.8.1 Linear markers

All populations (except Population 1B which is within a Nature Reserve) occurring along linear road and rail reserves have had permanent but discrete marker pegs installed. The installation of marker pegs has not stopped Populations 2 and 3 being damaged in 1990 and again in 1993.

1.8.2 Monitoring

All plants within the eleven known populations of Daviesia euphorbioides have been permanently marked with aluminium tags and their positions accurately mapped. Growth measurements and crown condition have been recorded for each plant in September 1989, 1991, 1992 and 1993 (Brown, in preparation).

1.8.3 Liaison and records

Confidential registers - precise locality details of known populations, are maintained in the CALM's Merredin District office and in the central record system at CALM's head office in Como. The register is updated regularly as required. Information on populations on CALM land will also be retained on individual Nature Reserve files.

Wildlife Management Program No.9 - Daviesia euphorbioides has been included in the Wildlife Management Program for threatened flora in CALM's Merredin District (Mollemans *et al.* 1993). The program provides a brief description of the appearance, distribution, habitat and conservation status of the threatened flora in the District and has recommendations for research and management action necessary to ensure their continued survival. The program included 33 species of Declared Rare Flora and 100 priority species. By ranking the species in priority order for these requirements, Departmental staff and resources can be allocated to species most urgently in need of attention. Daviesia euphorbioides was ranked number 5 in the plan.

RECOVERY

The recovery plan will run for a ten year period from 1994 to 2004 inclusive.

2.1 Objective and Criteria

The primary objectives the Recovery Plan are to secure the habitat adjoining the larger populations and manage them; protect genetically distinct populations; find, protect and manage any other natural populations; and establish new populations in suitable habitat on Nature Reserves so that the survival of the species and its genetic diversity is ensured.

The criteria for successful recovery will be:

2 years - revesting of land adjoining populations 1A, 1B, 2 and 3 at Wongan Hills. Collect and store seed from all populations. Search for additional populations on farmland.

5 years - rehabilitate and replant with D. euphorbioides gravel/sand pits adjoining Populations 1A and 1B. Populations of 100+ plants each to be established in conservation reserves from stands 2/3, 5/8 and 7. Complete research into flowering and seed biology and population genetics.

10 years - Self maintaining populations established or protected in conservation reserves. All known populations will be stable or increasing. Collect seed from all populations in long term storage. Representative sample of plants from each population maintained in cultivation.

2.2 Recovery Actions

Recovery actions for Daviesia euphorbioides are detailed below. These are costed in the Implementation Schedule (Figure 3). Costs are given in Australian dollars and no allowance has been made for inflation. Administration costs are incorporate into individual funding items.

2.2.1 Appointing the Recovery Team

A recovery team will be appointed to co-ordinate the implementation of the Recovery Plan. The team will comprise representatives from CALM Science and Information Division, Nature Conservation Division and Wheatbelt Region, ANPWS and others who may be involved in implementing this plan. The recovery team will report annually to CALM's Corporate Executive on the implementation of this plan.

2.2.2 Acquisition of Conservation Reserve at Wongan

The protection of as much potential habitat as possible is one of the most effective steps that can be recommended for the recovery of Daviesia euphorbioides.

The Water Reserve 16418 (985 ha) contains or adjoins the four largest populations at Wongan Hills, which contain 88% of all live plants recorded in September 1993. It has been recommended that the reserve be vested in the NPNCA. CALM will continue to negotiate the changes in vesting and management of the Water Reserve with the Western Australian Water Authority and the Wongan-Ballidu Shire Council.

Adjoining Water Reserve 16418 and north of Populations 2 and 3, there is a large parcel of uncleared native vegetation on the Department of Agricultures Wongan Hills Research Station (Reserve 18672). CALM is currently seeking to have it included in the Nature Reserve.

These two proposed Nature Reserves will be linked to Elphin Nature Reserve A25808 which adjoins the four Wongan populations.

There are several other threatened and rare flora on the Reserves which will benefit from this protection. A detailed floristic survey and vegetation mapping has been completed over the whole area (Coates 1988; Coates 1992).

2.2.3 Search for additional populations

Further searching in suitable habitat in the Wongan, Goomalling and Dowerin areas will continue. It appears unlikely that further populations will be located on linear rail and road verges. However, blocks of remnant vegetation on reserves and on private property have not been adequately surveyed. The latter will require the co-operation of the farming community to identify possible areas, provide access and be prepared to accept long term management constraints on sites located.

A contract botanist will be engaged for two seasons during the flowering period to implement this action. (The same botanist will be responsible for other actions.)

2.2.4 Protection of Habitat

2.2.4.1 Linear markers

As outlined in Section 1.8.1, permanent but discrete marker pegs have been installed at all ten populations occurring on linear road and rail reserves. The pegs need to be checked periodically and replaced by District staff if they have been damaged or removed. The placement of pegs at Populations 2, 3 and 7 may need to be reassessed and moved slightly in 1994 by District staff.

2.2.4.2 Protection from fire

All populations of Daviesia euphorbioides will be excluded from prescribed fuel reduction burns and are to be protected from wildfire's, until appropriate research has been carried out under Section 2.2.6.3. If any of the populations are burnt a weed control program should be undertaken to assist potential regeneration. No additional fire prevention methods (fire break installation or prescribed burning of adjacent native vegetation) are recommended.

2.2.4.3 Protection from dieback disease (Phytophthora spp)

Although dieback disease has not been recorded within the range of Daviesia euphorbioides it may threaten this species and its habitat in the future. All operations in the vicinity of Daviesia euphorbioides populations at Wongan Hills, are to be conducted under strict dieback hygiene conditions. Monitoring of the Wongan Hills sites will be undertaken periodically by CALM staff experienced in dieback detection and management.

2.2.5 Population and Habitat Enhancement

2.2.5.1 Seed collection

Seed will be collected from all populations in Spring/Summer of 1994 and 2000, so that the range of genetic and morphological diversity is represented. From Populations 2 and 3 seed will be collected from 50 randomly chosen individuals. From all the other populations seed will be collected from all plants where possible. Seed from individual plants will be kept separate at all times. Seed collection will be undertaken by a contract botanist.

The seed collected will be used for:

- propagation and re-introduction (2.2.5.3)
- establishment of new populations (2.2.5.4)
- viability testing (2.2.6.1)
- research into genetic systems (2.2.6.2)
- long-term storage (2.2.8.1)

The seed will be maintained in storage at the CALM seed store at Manjimup or the WA Herbarium. Viability of stored seed will be tested regularly and seed collection enhanced if required. All seed germinated during viability tests will be potted and grown-on for re-establishment in the field or in horticulture.

In 1994, cuttings will be taken from plants in Populations 2 and 3 to determine if it is a viable method of propagation. If so, it may need to be used on the 1-2 remaining plants in Populations 4, 5, 6, 8, and 9 if seed is unavailable or viability low.

2.2.5.2 Track closure and rehabilitation

The inner vehicle track closest to the railway line through Populations 2 and 3 will need to be closed to protect the 1990 cohort of seedlings from further damage. This is essential on the northern side of the line which should be closed from the crossing (to the west of Population 2) to just to the east of pole 15/9 (east of Population 3).

Westrail and other vehicles can travel along the outer track some 20-25 m from the line.

Bollards are to be installed at either end of the whole site, across side tracks and each end of Populations 2 and 3. A sign may be enstalled by Westrail at each end to inform staff. Work to be completed by the end of Summer 1993\94.

If a simple closure does not work then it is suggested both Populations 2 and 3 be fenced using ringlock and steel pickets.

2.2.5.3 Gravel pit rehabilitation and re-introduction

The sand pits adjoining Population 1A and Population 1B will be rehabilitated (including contouring and ripping) and replanted with Daviesia euphorbioides raised from seed from the original plants from Population 1A and 1B respectively. Populations of atleast 100 reproductive individuals will be established.

To maintain wild populations at each of the other eight populations about 15-25 seedlings will be planted out at each site in 1995 and 1996. Seed and seedlings will be kept separate so seedlings will be returned to the site they originated from.

The steps will involve:

a) obtaining seed and cuttings in late Spring from all populations (see Section 2.2.5.1),

b) propagate seedlings at the CALM nursery at Narrogin and raised to at least four months old before planting,

c) contour and rip sites, control weeds

d) plant Daviesia euphorbioides seedlings and broadcast seed other native species in June 1995 and 1996,

f) monitor the populations annually for three years,

g) plant additional seedlings if stocking is not enough.

2.2.5.4 Establish new populations

An additional two or three new populations may be established if a suitable disturbed site (e.g. old gravel\sand pit) can be found:

- on the proposed Nature Reserve at Wongan Hills using seed from Populations 2, 3 and 9.
- on the Nature Reserve near Dowerin using seed from Populations 5 and 8.
- on the Nature Reserve near Dowerin using seed from Population 7.

Given the site conditions within these three Nature Reserves and the population biology of this species (Section 1.5) it is possible that such sites may have contained Daviesia euphorbioides in the past. The site preparation and introduction of plants will closely follow Section 2.2.5.3.

2.2.6 Research

2.2.6.1 Flowering and seed biology

Follow through current flowering and seed cycle to determine: flowering time, number of flowers set, pod production, length of time pods and seed take to mature and when seed is shed. Once the seed is on the ground what impact do harvesting insects and vertebrates have, were is the seed stored. Sample soil near existing plants to determine seed store in the soil and to estimate how long seed remains viable in the soil?

Information on seed production, viability and the natural longevity of seed in the soil is necessary for understanding how the species persists in its habitat. Allied to that, it is important that we understand the mechanisms that trigger natural regeneration and early seedling survival.

A study on Daviesia euphorbioides seed biology will be carried out. Methods of harvesting seed from wild and cultivated plants will need to be developed. It will also be necessary to know the longevity of seed under storage conditions.

2.2.6.2 Genetic variability between populations

Allozyme studies are required to determine levels of genetic diversity and levels of inbreeding of populations; and the amount of genetic divergence between the populations.

Can seed from different populations be mixed? Genetically are the small one plant populations worth maintaining? Do the Wongan Hills populations differ significantly from the out-lying ones?

Allozyme studies will require 5-10 seeds from each of 20 plants per population. These can be collected from the Wongan Hills populations (1A, 1B, 2 and 3) and the Dowerin population (7). The six populations with only one live plant can also be tested but no comparison determined. In the longer term DNA finger-printing could be used on very small populations.

2.2.6.3 Regeneration through soil disturbance and fire

Fire may be used to trigger natural regeneration as shown in photographs by Rye (1980). Research into specifically tailored fire regimes (possibly hot Autumn burns) could be developed to regenerate senescent populations. The four Wongan Hills populations are the only sites were natural fuel loads appear high enough for such burns. A hot Autumn research burn may be carried out on one of the Wongan Hills

populations late in the term of this Recovery Plan (once the three proposed new populations have been established sections 2.2.5.3 and 2.2.5.4).

Chemical weed control may need to be done during the first 12 months after the research burn to assist regeneration.

2.2.6.4 Site surveys

To identify site characteristics associated with known populations 10m x 10m monitoring quadrants will be established at each site. Atleast two quadrants will be established on the disturbed part of each site where the Daviesia euphorbioides plants have established and two in adjoining native vegetation if possible. The soil profile will be described to 1m. The presence of all flora species will be recorded in both Spring and Autumn. The data will assist in searching for new populations.

2.2.6.5 Monitor and report on existing populations

For the 11 known populations monitoring and re measurement of all live plants and any further regeneration should be done in September each alternate year (1995, 1997, 1999, 2001). All new populations should be mapped and all plants measured following Brown (in preparation).

The monitoring program will provide up to date and accurate information on the status of populations of Daviesia euphorbioides in the wild. This will assist in understanding the population dynamics of this disturbance opportunist and provide early warning of population senescence.

If the number of plants in any population drops below 20 reproductive individuals consideration will be given to further site disturbance to encourage recruitment.

However, without significant regeneration of existing populations, and the establishment or discovery of new populations the monitoring program will just accurately document the demise of Daviesia euphorbioides in the wild.

2.2.7 Liaison and Public Education - Communications Plan

Issues

1. Daviesia euphorbioides is under threat of extinction in the next 10 years, with 6 of the 11 populations currently with only one plant alive.

2. Only one population is on a conservation reserve.

3. Several populations have been damaged by land managers and service providers in last 5 years.

4. Daviesia euphorbioides is a short lived , disturbance opportunist which requires management to regenerate in the wild.

Objectives

1. To minimise damage to populations by land holders, service providers and the public, through increased awareness and understanding of rare species, such as Daviesia euphorbioides

2. To promote attitudes and actions supportive of CALM's rare flora management.

3. To inform Local, State and Commonwealth government organisations and their appropriate staff of their obligations to help protect threatened species such as Daviesia euphorbioides.

4. Promote CALM as a part of the local community.

Target Audiences

* Land Managers (Shires, MRD, Westrail, WAWA, CALM)
* Service Providers (Telecom, MRD, Shires, Westrail, WAWA, SEC)
* Local Shire Councils (Wongan-Balidu, Goomalling, Dowerin)
* Local communities (Wongan, Goomalling, Dowerin)
* Local Politicians
* Local Schools
* Resourcing bodies (CALM, ANCA, private enterprise)

Strategies

1. Meet land managers, service providers and Councils to discuss management implications and obligations of Daviesia euphorbioides on their land.

2. Produce a leaflet to explain the current status of Daviesia euphorbioides and the need for land managers, adjoining land holders, service providers and Councils continued assistance to protect it. Also ask if they are interested in receiving an annual newsletter from the Recovery Team. This could be available for mailing or handing out in response to public enquires.

3. Establish and maintain Local Authority and MRD roadside threatened flora register.

4. Submit articles and photographs to local news services, concentrating on the heritage value of threatened flora and the need for action.

5. Submit an article and photographs to both CALM News and Landscope concerning the establishment of a Recovery Team and the threats to Daviesia euphorbioides.

6. Provide talks to local schools and community groups.

7. Provide nursery grown plants of Daviesia euphorbioides for the Wongan Hills rare species garden at the towns Council chambers.

8. Ensure CALM staff and decision makers are aware of the urgency of the work on this threatened species and the ramifications of the lack of action.

Messages

1. Urgency of action to prevent this species becoming extinct in the wild.

2. The flora in the wheatbelt is unique, endemic and increasingly threatened. However, we can still save most species if we work together.

3. Land managers and service providers (plus their staff) have obligations to protect rare species in the wild.

4. CALM wants to work with the community to protect and promote the areas unique flora.

5. CALM is approachable and concerned.

Actions

2.2.8 Ex situ Conservation

2.2.8.1 Germplasm storage

Seed from all known populations will be stored in the CALM seed store or at the WA Herbarium as set out in Section 2.2.5.1.

2.2.8.2 Herbarium specimens

The Western Australian Herbarium holds only 5 specimens of Daviesia euphorbioides - four from "Wongan Hills" (Drummond 1876, Gardner 1924, Carne & Gardner 1924, Demarz 1984) and one from Population 4 (Crisp 1980). Herbarium specimens will be collected from each of the known populations in 1994 and from new populations as they are discovered.

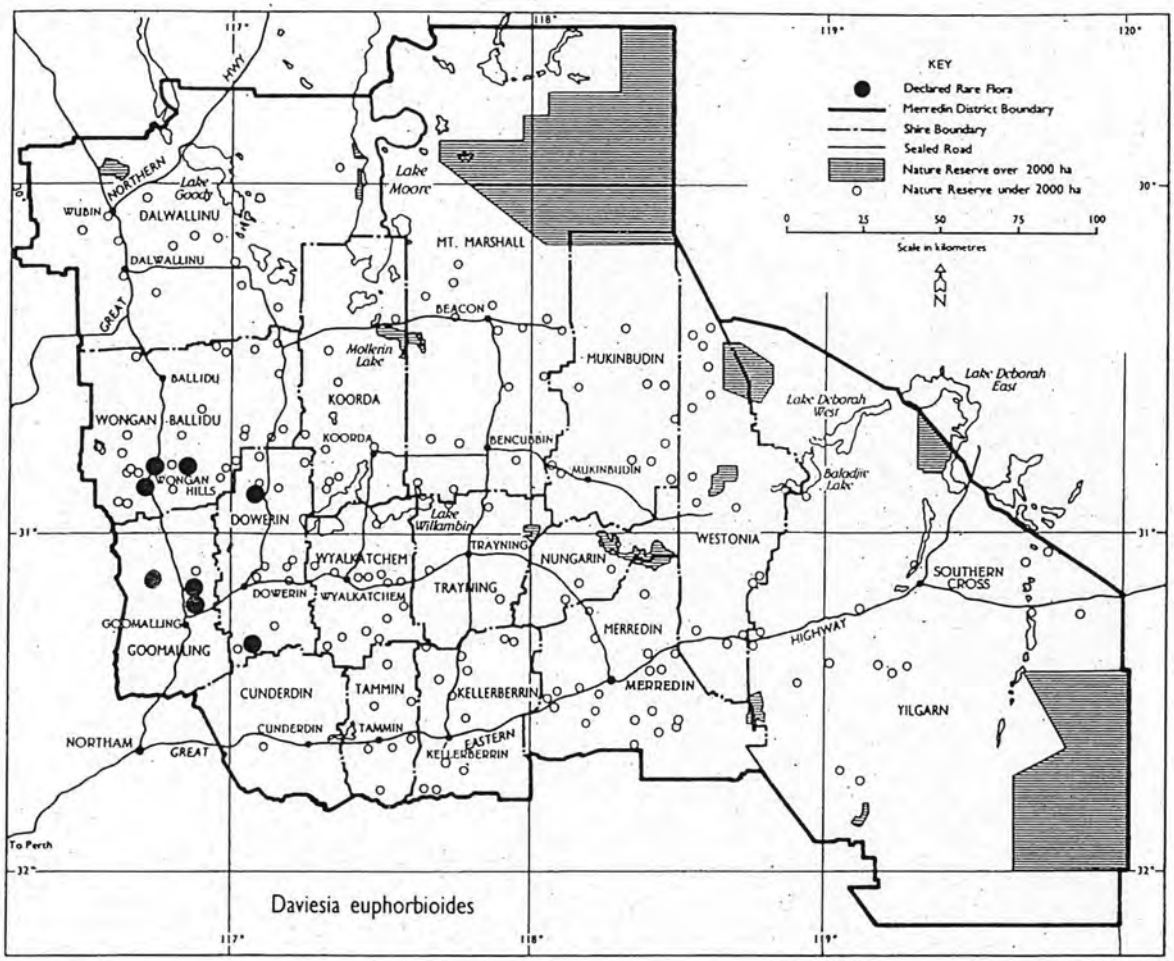

Figure 1: Distribution of Daviesia euphorbioides within WACALM's Merredin District (Mollemans 1993).

Figure 2: List of the known populations of Daviesia euphorbioides and current population size.

Popn No.	Shire	Land Status	Total No. of plants	No. Plants alive 9/93	Seedlings 1989-1993
1A	Wo-Ba	Road Reserve	35	10	-
1B	Wo-Ba	Nature Res.	46	21	6
2	Wo-Ba	Rail Reserve	153	55	70
3	Wo-Ba	Rail Reserve	167	94	87
4	Dowerin	Rail Reserve	3	1	-
5	Goomalling	Road Reserve	11	1	-
6	Wo-Ba	Road Reserve	2	1	-
7	Dowerin	Road Reserve	45	21	1
8	Goomalling	Road Reserve	2	1	-
9	Wo-Ba	Road Reserve	2	1	-
10	Goomalling	Road Reserve	3	1	-
TOTAL			**469**	**207**	**164**

Wo-Ba = Shire of Wongan Ballidue

Figure 3: Implementation schedule for the recovery of the threatened flora taxa Daviesia euphorbioides.

Task	Task Description	Priority	Responsible Party	1994	1995	1996	1997	1998	1999	2000
2.2.1	Recovery Team	High	WACALM	2000	2000	2000	2000	2000	2000	2000
2.2.2	Aquisition of Nature Reserve	Medium	WACALM -	1000	1000	1000				
2.2.3	Search for new populations	High	WACALM ANCA	800 1000	800 1000	800 1000				
2.2.4	Habitat protection	High	WACALM	200	300		300		300	
2.2.5.1	Seed Collection	vHigh	ANCA	2000	2000				2000	2000
2.2.5.2	Track Closure	vHigh	WACALM	2000						
2.2.5.3	Pit Rehabilitation & re-introduction	vHigh	WACALM ANCA		1000 2000	1000 1000				
2.2.5.4	Establish new populations	High	WACALM ANCA			500 1000	1000 1000			
2.2.6.1	Seed research	High	ANCA		5000	5000				
2.2.6.4	Site survey	Medium	ANCA		2000					
2.2.6.5	Monitoring	High	WACALM ANCA		500 500		500 1000	500	500 500	
2.2.7	Public Education	Medium	WACALM							
2.2.8	Ex situ conservation	High	WACALM ANCA Kings Park	500 2000	3000 1000	3000 1000				
	TOTAL		**WACALM** **ANCA** **Kings Park**	**6500** **4000** **0**	**5600** **15500** **1000**	**4800** **11000** **1000**	**2800** **2000** **0**	**2500** **0** **0**	**2800** **2500** **0**	**2000** **2000** **0**

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