

Glossy-leaved Hammer Orchid (*Drakaea elastica*)

RECOVERY PLAN



Department of Environment and Conservation
Kensington



FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos. 44 and 50. CALM formally became the Department of Environment and Conservation (DEC) in July 2006. DEC will continue to adhere to these Policy Statements until they are revised and reissued.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

DEC is committed to ensuring that threatened taxa and threatened ecological communities are conserved through the preparation and implementation of Recovery Plans (RPs) or IRPs, and by ensuring that conservation action commences as soon as possible and, in the case of Critically Endangered (CR) taxa and communities, always within one year of endorsement of that rank by the Minister.

This IRP will operate from April 2008 to March 2013 but will remain in force until withdrawn or replaced. It is intended that, if the species is still ranked CR, this IRP will be reviewed after five years and the need for further recovery actions assessed.

This IRP was approved by the Director of Nature Conservation on 30 April 2008. The allocation of staff time and provision of funds identified in this IRP is dependent on budgetary and other constraints affecting DEC, as well as the need to address other priorities.

Information in this IRP was accurate as of April 2008.

This IRP was prepared with financial support from the Australian Government to be adopted as a National Recovery Plan under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

IRP PREPARATION

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Cover photograph by Andrew Brown.

CITATION

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Department of Environment and Conservation (2009). Glossy-leafed Hammer Orchid (*Drakaea elastica*) Recovery Plan. Department of Environment and Conservation, Western Australia.

SUMMARY

Scientific Name:	<i>Drakaea elastica</i>	Common Name:	Glossy-leafed Hammer Orchid
Family:	Orchidaceae	Flowering Period:	September to early November
DEC Regions:	Midwest, South West and Swan	DEC Districts:	Blackwood, Moora, Perth Hills, Swan Coastal and Wellington
Local Government Authorities:	Armadale, Busselton, Capel, Chittering, Cockburn, Dandaragan, Gingin, Gosnells, Harvey, Kwinana, Murray, Rockingham, Serpentine-Jarrahdale and Waroona	Recovery Teams:	Moora District Threatened Flora and Communities Recovery Team, South West Region Threatened Flora and Communities Recovery Team and Swan Region Threatened Flora and Communities Recovery Team

Illustrations and/or further information: Atkins, K. (2008) *Declared Rare and Priority Flora List for Western Australia*, Department of Environment and Conservation, Western Australia; Brown, A., Thomson-Dans, C. and Marchant, N. (Eds) (1998) *Western Australia's Threatened Flora*, Department of Conservation and Land Management, Western Australia; Hoffman, N. & Brown, A. (1998) *Orchids of South-west Australia*, Revised 2nd edition with supplement, University of Western Australia Press, Nedlands; Carstairs, S. & Coates, D. (1994) *Conservation Genetics and Population Ecology of Five Rare and Threatened Western Australian Orchids*; Hopper, S.D. & Brown, A.P. (2007) A revision of Australia's hammer orchids (*Drakaea*: Orchidaceae), with some field data on species-specific sexually-deceived wasp pollinators, *Australian Systematic Botany* 20, 1–34; Evans, R., Willers, N. & Mitchell, D. (2003) *Threatened Flora of Swan Region*, Unpublished report to the Western Australian Department of Conservation and Land Management, and Environment Australia; Patrick, S. & Brown, A. (2001) *Declared Rare and Poorly Known Flora in the Moora District*, Department of Conservation and Land Management, Western Australia; Williams, K., Horan, A., Wood, S. & Webb, A. (2001) *Declared Rare and Poorly Known Flora in the Central Forest Region*, WA Wildlife Management Program No. 33, Department of Conservation and Land Management, Western Australia; Western Australian Herbarium (1998-) *FloraBase – The Western Australian Flora*, Department of Environment and Conservation, Western Australia, <http://florabase.calm.wa.gov.au/> (accessed 2007).

Current status: *Drakaea elastica* was declared as Rare Flora (as *D. jeanensis*) under the Western Australian *Wildlife Conservation Act 1950* in July 1988 and is ranked as Critically Endangered (CR) under World Conservation Union (IUCN) criterion B2ab(ii,iii,iv,v) (IUCN 2001) due to the severe fragmentation of populations and the continuing decline in the area, extent and quality of habitat and number of mature individuals. The main threats are land clearing, degradation and fragmentation of habitat, edge effects, density of ground-level vegetation, grazing, inappropriate disturbance, construction and maintenance work, rubbish dumping, weeds, disease, inappropriate fire regimes, poor recruitment and salinity. *D. elastica* is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Description: *Drakaea elastica* has a slender flower stem up to 30 cm high and a single distinctively glossy, bright green, prostrate, heart-shaped leaf 1 to 2 cm in diameter. The leaf emerges in May and starts to wither by the time the orchid flowers in September. The single flower is 3 to 4 cm long with a hinged labellum. Flowers are first seen in late September and continue flowering until late October or more rarely early November. Individual plants may not flower every year. The plant dies back to a dormant underground tuber over summer. The best time to look for the plant is in July and August when the leaves are relatively conspicuous.

Habitat requirements: *Drakaea elastica* is currently known only from the Swan Coastal Plain over a range of approximately 350 km between Catby in the north and Busselton in the south. The species grows on bare patches of sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps, typically in banksia (*Banksia menziesii*, *B. attenuata* and *B. ilicifolia*) woodland or spearwood (*Kunzea glabrescens*) thicket vegetation. *D. elastica* often occurs with other orchid species such as *Drakaea glyptodon* (king-in-his-carriage), *D. livida* (warty hammer orchid) and *Paracaleana nigrita* (flying duck orchid). The increased rates of survival in sites with relatively little direct sun exposure (Carstairs and Coates 1994) indicate a requirement for shady canopy cover to be present.

Habitat critical to the survival of the species, and important populations: Habitat critical to the survival of the species includes the area of occupancy of important populations; areas of similar habitat surrounding important populations (i.e. low-lying areas of deep sand supporting banksia woodland or spearwood thicket), as these areas provide potential habitat for natural range extension and are necessary to support viable populations of the associated mycorrhizal fungus and the pollinating wasp species crucial to the orchid's survival, and to allow pollinators to move between populations; and additional occurrences of similar habitat that may contain important populations of the species or be suitable sites for future translocations or other recovery actions intended to create important populations.

Given that this species is listed as Endangered (EPBC Act), it is considered that all known habitat for wild and translocated populations is habitat critical to its survival, and that all wild and translocated populations are important populations.

Benefits to other species or ecological communities: *Caladenia huegelii* (listed as DRF under the Wildlife Conservation Act, ranked as Critically Endangered in WA, and listed as Endangered under the EPBC Act) occurs at the same site as Population 29 of *Drakaea elastica*, and *Drakaea micrantha* (listed as DRF under the Wildlife Conservation Act, ranked as Endangered in WA, and listed as Vulnerable under EPBC Act) occurs at the same site as Population 35 of *Drakaea elastica*. Recovery actions such as the negotiation of agreements that protect *Drakaea elastica* and its habitat and the management of fire, disease and weeds will protect these other rare flora species and the ecological community in which they occur.

International obligations: This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that Convention. *Drakaea elastica* is listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), ratified by Australia in July 1976. The aim of that convention is to ensure that international trade in listed species does not threaten their survival (UNEP-WCMC 2007). This plan is in full accord with that aim.

Indigenous consultation: Involvement of the Indigenous community is being sought through the Indigenous reference groups for the Northern Agricultural Catchment Council, Swan Catchment Council and South West Catchment Council to determine whether there are any issues or interests identified in the plan. A search of the Department of Indigenous Affairs' Aboriginal Heritage Sites Register has identified a number of sites in the area of *Drakaea elastica* populations.

Where no role is identified for the indigenous community associated with this species in the development of the recovery plan, opportunities may exist through cultural interpretation and awareness of the species. Indigenous involvement in the implementation of recovery actions will be encouraged.

Social and economic impact: A number of proposed infrastructure and other land development proposals have the potential to impact populations of *Drakaea elastica*. Consultation is occurring with the proponents, and the potential impact of the proposals on this species is being considered in environmental impact assessments by the State and Commonwealth authorities. Impact minimisation is the aim of consultation, and appropriate environmental offsets are negotiated where impact will still occur.

The implementation of the rest of the *Drakaea elastica* recovery plan is unlikely to cause significant adverse social or economic impacts. However, as some populations are located on private property and in areas leased for mining activities, their protection may potentially affect farming and mining activities. Recovery actions will involve liaison and cooperation with all stakeholders with regard to these areas.

Affected interests: Stakeholders potentially affected by the implementation of this plan include managers of land on which *Drakaea elastica* occurs, including private property owners, Main Roads Western Australia, Southern Gateway Alliance, Iluka Resources Limited, Jandakot Airport Holdings, Western Power Corporation, Alinta Limited, Shire of Capel, Shire of Harvey, City of Armadale and DEC.

Evaluation of the plan's performance: The Department of Environment and Conservation will evaluate the performance of this recovery plan in conjunction with the South West Region, Swan Region and Moora District Threatened Flora and Communities Recovery Teams. In addition to annual reporting on progress with listed actions and comparison against the criteria for success and failure, the plan is to be reviewed within five years of its implementation.

Completed recovery actions

1. Relevant land managers have been made aware of the location and threatened status of the species.
2. Liaison between DEC and relevant land managers is ongoing.
3. Staff from DEC's South West Region, Swan Region and Moora District monitor populations of the species.
4. Further surveys for additional populations have been undertaken, and new populations located.
5. Fencing has been installed to protect a population from grazing.
6. Three separate salvage operations have been made for small numbers of plants in the path of construction works.
7. Orchid and fungus tissue culture material and seed has been collected and stored at the Botanic Gardens and Parks Authority.

Ongoing and future recovery actions

1. Investigations into the biological and ecological requirements of *Drakaea elastica*'s pollinator and associated mycorrhizal fungus have commenced.
2. An information sheet that describes and illustrates the species has been prepared and will be printed in the near future.
3. The South West Region, Swan Region and Moora District Threatened Flora and Communities Recovery Teams are overseeing the implementation of this recovery plan and will include information on progress in an annual report to DEC's Corporate Executive and funding bodies.

Recovery plan objective: The objective of this recovery plan is to abate identified threats and maintain or enhance viable *in situ* populations to ensure the long-term preservation of the species in the wild.

Criteria for success: The total number of mature (flowering) plants and/or the area of occupancy is maintained over the five year term of the plan.

Criteria for failure: The total number of mature (flowering) plants and/or the area of occupancy has decreased by twenty percent or more over the five year term of the plan.

Recovery actions

1. Coordinate recovery actions
2. Liaise with appropriate stakeholders
3. Reduce impact of grazing on seed production
4. Negotiate agreements that protect *D. elastica* and habitat
5. Undertake hand pollination
6. Collect and store seed
7. Monitor populations
8. Obtain biological and ecological information
9. Implement weed control
10. Develop and implement a fire management strategy
11. Develop and implement a phytophthora strategy
12. Conduct further surveys
13. Develop best practice protocols for translocations
14. Promote awareness
15. Map habitat critical to survival
16. Review the Plan

1. BACKGROUND

History

Drakaea elastica was, until recently, known as *Drakaea jeanensis*, a name given to it by Richard Rogers in 1920. However, it is now known that the species was described as *Drakaea elastica* by John Lindley in 1839 in his *Sketch of the Vegetation of the Swan River Colony*. Clements reinstated this name in 1989. Unfortunately, to confuse the matter even more, the name *Drakaea elastica* was for many years mistakenly applied to the warty hammer orchid, which is now correctly known as *Drakaea livida*.

Drakaea elastica is widely distributed on the Swan Coastal Plain between Cataby (approximately 130 km north of Perth) and Busselton (approximately 200 km south west of Perth) and is likely to have been more common before widespread clearing for housing and agriculture.

Drakaea elastica was declared as Rare Flora in 1988 (as *D. jeanensis*) after surveys confirmed its rarity. Populations are being monitored regularly by DEC (particularly with regard to invasive weeds), and where possible are being protected from fire during the vegetative and flowering phase. Survey within the known range of the species has continued to find new populations. Unfortunately, the majority of these are small, and with decline occurring at many known populations, have not improved the conservation status of the species.

Drakaea elastica is currently known from forty two populations, twenty seven of which contain fewer than fifteen plants. More than half of all known plants are located in just one population, while almost 90% of plants occur within seven populations. These sites are of high value for the conservation of the species, but maintenance of a range of sites across the distribution of the species is important to ensure the conservation of genetic variation.

Description

Drakaea elastica is a small orchid with a single distinctively glossy, bright green, prostrate, round to heart-shaped leaf, 1 to 2 cm in diameter. The leaf emerges in May, and starts to wither by the time the orchid flowers in September. The single flower, on a slender flowering stem to 30 cm high, is 3 to 4 cm long with a hinged hammer-like lip (labellum). The two other petals and all three sepals are small and slender. Flowers are first seen in late September, extending to October and rarely early November. However, it is important to note that each plant may not flower every year. The plant dies back to a dormant underground tuber over summer. The best time to look for the plant is in July and August when the glossy-green leaves are relatively conspicuous.

Drakaea elastica is closely related to *Drakaea concolor* but can be distinguished by its glossy, light-green leaf, generally later flowering period and much more southerly distribution. *D. concolor* flowers in August, September and occurs in the Kalbarri-Eneabba area. *D. elastica* is distinguished from all other *Drakaea* species by its glossy light-green leaf. *D. glyptodon* and *D. livida* often grow with *D. elastica* but *D. glyptodon* has a grey, often prominently veined leaf while *D. livida* has a dull, slightly grey-green leaf (Hoffman and Brown 1998).

Distribution and habitat

Drakaea elastica is currently known over a range of approximately 350 km between Cataby in the north and Busselton in the south. The species grows on bare patches of grey-white sand within otherwise dense vegetation in low-lying areas alongside winter-wet swamps and flats, typically in banksia (*Banksia menziesii*, *B. attenuata* and *B. ilicifolia*) woodland or spearwood (*Kunzea glabrescens*) thicket vegetation. *D. elastica* often occurs with other species of orchid, such as *Drakaea glyptodon* (king-in-his-carriage), *D. livida* (warty hammer orchid), *Paracaleana nigrata* (flying duck orchid), *Leporella fimbriata* (hare orchid) and *Pyrorchis nigricans* (red beaks) (Carstairs and Coates 1994; Hoffman and Brown 1998).

The decline of some populations may be partly due to increased density of native understorey vegetation following fire, leading to increased competition. Although the species occupies bare patches of soil within its habitat, the increased rates of survival in sites with relatively little direct sun exposure (Carstairs and Coates 1994) indicate a requirement for shady canopy cover to be present.

Biology and ecology

Ten species of *Drakaea* (hammer orchids) are currently recognised (Hopper and Brown 2007). All species emit pheromones that attract male thynnid wasps as pollinators, with each orchid species pollinated by a different species of thynnid wasp. The labellum of each hammer orchid roughly resembles the flightless female wasp of the pollinating wasp species. When the male tries to fly off with the supposed female mate, the hinged labellum causes the wasp to knock against the column of the flower, resulting in either the deposit or removal of pollen. Collections have been made of the thynnid wasp responsible for pollinating *D. elastica*, and it is believed to be an undescribed species. These wasps are known to require an abundant source of nectar on which to feed, and the presence of a particular scarab beetle that they parasitise to complete their life cycle. The size of vegetated area required to support a viable population of this pollinating wasp is unknown, but this complex ecological requirement must be taken into consideration with regard to applications to clear habitat of *Drakaea elastica*.

Drakaea seed is very fine and is wind-dispersed, often for many kilometres. Like other south-western Australian orchids, *Drakaea elastica* relies on an association with a mycorrhizal fungus to germinate its seed and to supply nutrients to the plant throughout its life cycle. The fungus inserts hyphae into the outer cells of the collar region of the underground stem of the orchid just below the soil surface. From these the orchid absorbs minerals and nutrients. The group of fungi associated with *Drakaea* species is exceptionally difficult to culture (Ramsay *et al.* 1986; cited in Hopper and Brown 2007). If the fungus disappears from the habitat, the orchid cannot survive. *D. elastica* typically occurs in areas of sparse understorey, on bare sand or with light leaf litter. It appears that its fungus also prefers these areas (R. Phillips¹ pers. comm.). Early observations are suggesting that the fungus may be able to survive in more nutrient-poor soils than other fungi (R. Phillips pers. comm.). If the nutrient status of a site becomes richer, this fungus may be out-competed by other fungi and decline, also leading to the decline of *D. elastica* at that site.

Also like the majority of other south-west orchids, *Drakaea elastica* dies back to an underground storage tuber during the dry summer months and resprouts following the onset of autumn rains. Grazing of leaves and flowers reduces the reproductive and photosynthetic capacity of the species and reduces vigour in subsequent years.

Phytophthora species are plant pathogens that cause roots to rot and result in plant death from stress. Orchids appear to have some resistance to *Phytophthora* (dieback disease), perhaps due to their ability to control associated mycorrhizal fungi (K. Dixon² pers. comm.). Little research has been done, but it appears that *Phytophthora* is probably not damaging to the mycorrhizal fungi (K. Dixon pers. comm.). The susceptibility of *Drakaea elastica*'s spearwood thicket habitat is unknown, but is thought to be moderate. The banksia woodland habitat which *D. elastica* also occupies is highly susceptible. Changes in the structure of the habitat caused by *Phytophthora*, such as opening up the canopy and increasing the density of lower dieback resistant plants, could impact on *D. elastica* and its mycorrhizal fungus.

Drakaea elastica plants are likely to be killed by fire during their active growing period (late April – October) but not damaged during their dormant period (November – early April). Indirect impacts are possible through loss of canopy cover or increased weed competition.

Population size has been found to be correlated to autumn-early winter (April-June) rainfall, with greater autumn-winter rainfall resulting in higher numbers of plants present. This underlines the importance of repeated monitoring, and the need for caution when assessing the conservation value of small populations (Carstairs and Coates 1994). Hydrology seems to be important to this species as it often occurs near water courses or damp areas. The exact nature of the water requirements of *D. elastica* and its associated fungus are poorly understood.

Increased plant survival in sheltered (approximately one hour of direct sunlight) versus exposed (approximately

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4 hours of direct sunlight) quadrats has been observed. This may possibly be related to reduced heat stress, insect damage and fungal infection that were all observed in exposed quadrats (Carstairs and Coates 1994).

Carstairs and Coates (1994) found population size to be correlated to disturbance of the habitat, with higher numbers of plants at sites that had been disturbed less than seven years earlier than the time of monitoring. Disturbed areas associated with higher numbers of plants included disused vehicle tracks, kangaroo runs and areas burnt during wildfire. They also found that exposed plants had significantly less chance of survival, indicating that habitat must still retain enough canopy vegetative cover after disturbance to protect *Drakaea elastica* and its fungus from desiccation.

It should be noted that in these cases the orchid is not responding to disturbance directly, but colonising via wind-borne seed the open ground that disturbance often creates. *Drakaea elastica* grows in patches of open ground within vegetation, whether natural or artificially created. The higher numbers Carstairs and Coates recorded from recently (less than seven years) disturbed areas may be a result of the amount of bare ground available, which would decline as other low vegetation regenerated.

Disturbance at existing populations typically has a negative impact. Apart from direct physical impact to individual orchids, indirect impacts include increased weeds (generally highly competitive with *D. elastica*), increased presence of nutrients, increased access (potentially affecting canopy health) and changes to water regimes. While some single event disturbance types at appropriate times of year may be survivable, this species does not generally endure repeated disturbance or the habitat changes that it may bring.

Genetic analysis undertaken by Carstairs and Coates (1994) indicated that there was considerable divergence amongst the five populations analysed. This supports the strategy of conserving populations across the species' range, even if the populations appear to be small. There is considerable evidence of orchid species recovering from genetic bottlenecks caused by low numbers of plants. Carstairs and Coates (1994) identify higher than expected frequency of heterozygotes in this species, and suggest that populations containing more than 10 plants may serve the purpose of preserving the genetic resources of this species. These researchers also highlight the inadvisability of artificial gene flow between populations, including the translocation of individuals from one population into another, given the high levels of divergence between populations (Carstairs and Coates 1994).

Rates of natural pollination are still being examined, but Phillips has observed rates of natural seed set comparable to other *Drakaea* species at Population 18 and Subpopulation 37b. Initial observations also suggest that fruit set in *Drakaea* may be limited by a lack of natural pollination, as supplementary hand pollination results in successful fruit set.

Techniques are not yet available for the propagation of *Drakaea* species. This is possibly due to the difficulties in propagating the fungus. It is hoped that research currently underway on the biology and ecology of the mycorrhiza will help overcome this. Similarly, attempts to translocate mature plants/tubers have not been successful to date, which may also be due to the specific requirements of the fungus.

Threats

The main threats are land clearing, degradation and fragmentation of habitat, edge effects, density of ground level vegetation, grazing, inappropriate disturbance, construction and maintenance work, rubbish dumping, weed invasion, disease, inappropriate fire regimes, poor recruitment and salinity.

- **Land clearing** for housing, industrial development, roads and agriculture is proposed or is likely to be proposed in the future at a number of sites where *D. elastica* occurs.
- **Degradation and fragmentation of habitat** represents a threat to many populations. The often small size and poor condition of associated native vegetation has implications for the presence and frequency of pollinators and may expose the orchid to disturbances and edge effects. In addition, the lack of available habitat for recruitment is of concern.
- **Edge effects** severely affect populations that occur in small or narrow, linear vegetation remnants through exposure to weeds, increased wind speed, fertiliser and herbicide spray drift and runoff, modified hydrology and altered disturbance regimes, including fire and grazing.

- **Increased density of ground-level native vegetation** has resulted in the disappearance of *D. elastica* in several populations.
- **Grazing** of flower buds has been observed in many populations and, although it is unknown if grazing is by vertebrate or invertebrate herbivores, there is evidence of the presence of rabbits and kangaroos at many populations. Some flower buds were still grazed after vertebrates were excluded at Population 18, suggesting at least some grazing may be by grasshoppers or caterpillars. Note that exclusion of invertebrates would also exclude wasp pollinators. While grazing of flowers will not impact on the survival of the individual plant, it will impact on seed production for plant generation in the population. The activities of vertebrate grazers may also cause associated impacts as described below.
- **Rabbits, kangaroos and livestock** contribute to degradation of habitat at several populations. Soil disturbance, grazing of associated plant species, introduction of weed seed and the addition of nutrients are all effects of animal movement in these areas.
- **Construction** of infrastructure and other land development has the potential to directly impact on the species and its habitat through land clearing, and to indirectly impact through the reduction in habitat size, quality and connectivity.
- **Powerline, gas pipeline, firebreak and road maintenance** have potential to impact on plants at a number of populations and must be undertaken with due care.
- **Rubbish dumping** can introduce weeds as well as taking up habitat area. The movement of people in and out of an area to dump rubbish also creates a high level of disturbance. Fires are sometimes associated with rubbish dumping.
- **Weeds** are present at several populations. Often this is low level presence of flatweed (*Hypochaeris* sp.), which is hard to control in proximity with *Drakaea elastica* – hand weeding is not practical, and application of chemical would carry risk to the orchid as the flatweed emerges from the soil after *D. elastica*. In areas where weeds with more biomass (e.g. grasses or bulbous weeds) are present, *D. elastica* has disappeared.
- **Disease** could be a serious threat to Subpopulation 14d and Population 25 as the presence of *Phytophthora* species is affecting the health of some of the banksia woodland in their vicinity. There are also some dead banksias that may indicate *Phytophthora* presence in parts of the Nature Reserve supporting Population 13. These affected areas are not immediately adjacent to areas supporting *Drakaea elastica*, but may be an issue in future. The plant pathogen causes the roots to rot and results in death of the affected plant from drought stress. *Drakaea elastica* and its associated mycorrhizal fungus are not thought to be affected by *Phytophthora*, but the banksia woodland habitat the orchid occupies is thought to be highly susceptible. The susceptibility of spearwood thicket habitat remains untested at this time (Colin Crane³ pers. comm.), but may be moderate. Changes in the structure of the habitat caused by *Phytophthora*, such as opening up of the canopy, could have an impact on *D. elastica*, its fungus and its pollinator.
- **Inappropriate fire regimes** may affect the viability of populations. A hot fire burnt through Population 9 in 1985 and no plants have been seen at the site since. Experience with other terrestrial orchids from the south west of WA has suggested that plants are most vulnerable to fire during the vegetative/flowering stage (for *Drakaea elastica*, late April – October) when the plant has not yet replaced or fully replaced the tuber for the summer dormancy phase. If management burns (e.g. for fuel reduction) are considered in areas where *D. elastica* occurs it is strongly recommended that they should not take place in April through October. The species does not require fire to complete its life cycle and where feasible should be protected from frequent uncontrolled fires by the construction of fire breaks or by fuel reduction in surrounding areas. The placement of firebreaks needs to be carefully considered so that they do not become a vector introducing or exacerbating weeds, grazing etc. Infrequent fire may be beneficial in some habitats to open up the vegetation and create more bare areas at ground level. Fire may also change the habitat occupied by *D. elastica*. Thickets of *Kunzea glabrescens* have a typically open understorey that is favoured by *D. elastica*. Burning of these thickets results in the killing of mature *Kunzea glabrescens* and, following the germination of native plant species, a closing up of the habitat.
- **Poor recruitment** is apparent in many populations where plant numbers continue to decline. As some of these populations are in habitat that appears to be intact, the reasons for the decline are unclear but may be linked to successive years of poor rainfall, declining fungus presence, low pollinator presence or absence of suitable disturbance. Research is necessary to establish and quantify the presence and cause of these factors.

³ Mr Colin Crane, Senior Technical Officer (Phytophthora research), DEC's Science Division.

- **Recreational use** of the areas supporting Populations 14, 15, 16, 17 and 27 is of concern. Dirt bike and similar disturbance threatens the orchids at all these populations. Population 27 occurs in vestigial vegetation within a disused sandpit. This area is also well-known to local people as an orchid site and it is thought some picking of flowers may occur.
- **Sand extraction** is occurring on a small scale in the area of Population 27, which could impact directly on *D. elastica* or indirectly through changes to associated vegetation and/or water regimes. Gravel extraction is also occurring within approximately 200m of the population. This is less likely to impact directly on the orchids as it is not appropriate habitat, but may affect associated vegetation or water regimes.
- **A rising saline water table** in the vicinity of Population 25 is likely to have a deleterious effect on orchid, fungus and habitat.

Summary of population information and threats

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Manager	Year	No. plants	Condition	Threats
1. Yarloop	Perth Hills	Harvey	Minister for Transport	Road reserve	Main Roads Western Australia	1979 1988 2002 2005 2007	7 # 0 0 0 0	Presumed Extinct	Habitat present but no plants seen for many years. Population was always small. <ul style="list-style-type: none"> Density of ground-level vegetation Inappropriate fire Poor recruitment
2a. Mandogalup	Swan Coastal	Kwinana	Freehold	Private property	Landholders	1982 1990 2002 2005	30* # 0 0 0	Extinct	Cleared – housing
2b. Mandogalup	Swan Coastal	Kwinana	Freehold	Private property	Landholders	1982 1990 2002 2005	* 3 # 0 0	Extinct	Cleared – housing
2c. Mandogalup	Swan Coastal	Kwinana	Freehold	Private property	Landholders	1982 1990 2002 2005	* 5 # 0 0	Extinct	Cleared – housing
3a. Capel	Blackwood	Capel	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	1982 1991 1991 1993 1997 1999 2006 2007	ca 90* # 7 # 63 # 20 # 0 0 1 fl, 2 veg 4 #	Poor	<ul style="list-style-type: none"> Habitat degraded – high presence of weeds and rabbits Powerline maintenance – potential for future; no plants currently close enough Inappropriate fire Poor recruitment
3b. Capel	Blackwood	Capel	Unvested reserve	Road reserve	Shire of Capel	1982 1984 1989 1997 2006	* 20 # 0 0 0	Poor	<ul style="list-style-type: none"> Habitat degraded – high presence of weeds and rabbits Road maintenance – potential for future; no plants currently close enough Inappropriate fire Poor recruitment

Recovery Plan for *Drakaea elastica*

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Manager	Year	No. plants	Condition	Threats
4. Busselton	Blackwood	Busselton	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	1985 1990 1992 1993 1997 2005	6 # 9 # 7 # 13 # 0 0	Poor	<ul style="list-style-type: none"> Habitat degraded – high presence of weeds, rabbits, rubbish and disease. Inappropriate fire Poor recruitment
5. South west of Yarloop	Wellington	Harvey	Unvested reserve	Road reserve	Shire of Harvey	1977 1988 2005	2 # 0 0	Presumed Extinct	<p>Population always small; on narrow disturbed road verge.</p> <ul style="list-style-type: none"> Inappropriate fire Poor recruitment
6. North west of Yarloop	Swan Coastal	Waroona	Freehold	Private property	Landholders	1978 1985 1988 2005	1 # 0 0 0	Presumed Extinct	<p>Population always small; on grazed, cleared farmland.</p> <ul style="list-style-type: none"> Inappropriate fire Poor recruitment
7. Forrestdale	Swan Coastal	Serpentine-Jarrahdale	Freehold	Private property	Landholders	1986 1988 1990 2005	7 # 0 0 0	Extinct	Cleared – housing
8. Armadale	Swan Coastal	Armadale	Unvested reserve	Road reserve	City of Armadale	1978 1986 1988 2001 2005	2 # 0 0 0 0	Presumed Extinct	<p>Atypical habitat, but habitat intact. Population always small and no plants seen for many years.</p> <ul style="list-style-type: none"> Inappropriate fire Poor recruitment
9. Bindoon	Perth Hills	Chittering	Freehold	Private property	Landholders	1985 1988	2+ # 0	Unknown	<p>Unable to monitor in 2005; Note 1988 survey states plants were burnt in 1985 and not seen since.</p> <ul style="list-style-type: none"> Inappropriate fire Poor recruitment Clearing (if land sold)
10. Canning Vale	Swan Coastal	Gosnells	Freehold	Private property	Landholders	1988 2005	3 # 0	Presumed Extinct	Only a very small piece of typical habitat within larger piece of vegetation. Considered highly unlikely to be found there again.
11a. North west of Brunswick	Wellington	Harvey	Freehold	Private property	Landholders	1987 1990	200+ fl, 300+ veg* 0	Unknown	<p>Subdivided and sold after discovery. Thought to be cleared, but a drive by suggested there may be suitable habitat still present.</p> <ul style="list-style-type: none"> Clearing Inappropriate fire Poor recruitment

Recovery Plan for *Drakaea elastica*

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Manager	Year	No. plants	Condition	Threats
11b. North west of Brunswick	Wellington	Harvey	Freehold	Private property	Landholders	1987 1990	* 0	Unknown	<ul style="list-style-type: none"> • Clearing • Inappropriate fire • Poor recruitment
12. Canning Vale	Swan Coastal	Gosnells	Freehold	Private property	Landholders	1988 2000 2005	2 # 2 # 0	Extinct	Cleared – housing
13a. Pinjarra	Swan Coastal	Murray	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	1989 1991 2005 2006	300 # 300 # 63 fl, 393 veg* 36 fl, 229 veg*	Healthy; few flowers survive to seedset	<ul style="list-style-type: none"> • Grazing of buds and flowers (vertebrate or invertebrate grazer?) • Weed presence in some areas, rarely where plants are concentrated • Some banksia deaths may be caused by phytophthora, but these are not where plants are concentrated. • Inappropriate fire
13b. Pinjarra	Swan Coastal	Murray	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	1991 2005 2006	144 # * *	Healthy; few flowers survive to seedset	<ul style="list-style-type: none"> • Grazing of buds and flowers (vertebrate or invertebrate grazer?) • Weed presence in some areas, rarely where plants are concentrated • Some banksia deaths may be caused by phytophthora, but these are not where plants are concentrated. • Inappropriate fire
14a. Capel	Blackwood	Capel	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	1992 1997 2005 2007	98 # 32 # 12 fl, 27 veg 115 #	Healthy	<ul style="list-style-type: none"> • Grazing of buds and flowers (vertebrate or invertebrate grazer?) • Recreational use of area • Inappropriate fire • Poor recruitment
14b. Capel	Blackwood	Capel	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	1992 1997 2005 2007	4 # 1 # 1 fl 11 #	Habitat intact; population declining	<ul style="list-style-type: none"> • Recreational use of area • Inappropriate fire • Poor recruitment

Recovery Plan for *Drakaea elastica*

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Manager	Year	No. plants	Condition	Threats
14c. Capel	Blackwood	Capel	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	2007	8 #	Healthy	<ul style="list-style-type: none"> Grazing of buds and flowers (vertebrate or invertebrate grazer?) Recreational use of area Inappropriate fire Poor recruitment
14d. Capel	Blackwood	Capel	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	2007	100 #	Healthy	<ul style="list-style-type: none"> Grazing of buds and flowers (vertebrate or invertebrate grazer?) Active <i>Phytophthora cinnamomi</i> presence Recreational use of area Inappropriate fire
15. Capel	Blackwood	Capel	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	1992 1997 2005 2007	20 # 3 # 1 veg 82 #	Healthy	<ul style="list-style-type: none"> Light kangaroo presence Light weed presence Grazing of associated orchid leaves – caterpillars? Recreational use of area Inappropriate fire
16a. Capel	Blackwood	Capel	Shire of Capel	Sanitary and Sand	Shire of Capel	1992 1997 2005 2007	1 # 1 # 0 0	Poor	<ul style="list-style-type: none"> Habitat heavily degraded by weeds, kangaroos and rabbits Recreational use of area Inappropriate fire Poor recruitment
16b. Capel	Blackwood	Capel	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	1992 1997 2007	3 # 6 # 7 #	Moderate	<ul style="list-style-type: none"> Some weed invasion Recreational use of area Inappropriate fire Poor recruitment
16c. Capel	Blackwood	Capel	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	1992 1997 2007	1 # 62 # 235 #	Moderate	<ul style="list-style-type: none"> High level of weed presence High level of kangaroo disturbance Recreational use of area Inappropriate fire

Recovery Plan for *Drakaea elastica*

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Manager	Year	No. plants	Condition	Threats
16d. Capel	Blackwood	Capel	Shire of Capel	Sanitary and Sand	Shire of Capel	1992 1997 2005 2007	13 # 22 # 8 fl, 9 veg 6 #	Moderate	<ul style="list-style-type: none"> Some weed invasion Recreational use of area Inappropriate fire
16e. Capel	Blackwood	Capel	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	1992 1997 2007	2 # 0 3 #	Poor	<ul style="list-style-type: none"> Ground layer dense – unsuitable for <i>D. elastica</i> Recreational use of area Inappropriate fire Poor recruitment
17. Capel	Blackwood	Capel	Non-vested	Settlers requirements	-	1992 1997 2005 2007	16 # 0 1 fl, 7 veg 9 #	Healthy	<ul style="list-style-type: none"> Patchy weeds around rabbit diggings/middens; kangaroo activity evident Recreational use of area Inappropriate fire Poor recruitment
18. Capel	Blackwood	Capel	Freehold	Private property	Landholders	1992 2004 2007	120 # 370+ # 369 #	Healthy	<ul style="list-style-type: none"> Grazing of buds and flowers (vertebrate or invertebrate grazer?) Inappropriate fire
19. Capel	Blackwood	Capel	Freehold	Private property	Landholders	1992 2005 2007	150 # 10 fl, 34 veg 24 fl, 48 veg	Moderate	<ul style="list-style-type: none"> Grazing of buds and flowers (vertebrate or invertebrate grazer?) Inappropriate fire Poor recruitment
20. Capel	Blackwood	Capel	Freehold	Private property (Mining Lease)	Landholders, Iluka Resources Ltd	1992 2006 2007	68 # 11 fl, 46 veg 94 #	Healthy	<p>Large area of bush present, plants scattered across.</p> <ul style="list-style-type: none"> Inappropriate fire
21. Cataby	Moora	Dandaragan	Freehold	Private property	Landholders	1992 1993 2005	2 fl, 6 veg 2 fl, 5 veg 1 fl, 11 veg	Healthy	<p>Large area of bush present, but a thorough inspection in 1993 and again in 2005 found only small numbers of plants. Patchy fungus distribution may be a limiting factor</p> <ul style="list-style-type: none"> Inappropriate fire Poor recruitment
22. Mundijong	Swan Coastal	Serpentine-Jarrahdale	Freehold	Private property	Landholders	1991 1996 2005	3 fl, 16 veg 0 0	Habitat intact, orchid not present	<p>1996 survey completed while clearing drill lines. In 2005, habitat intact, other orchids present. <i>D. livida</i> was common at site; now rare.</p> <ul style="list-style-type: none"> Inappropriate fire Poor recruitment

Recovery Plan for *Drakaea elastica*

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Manager	Year	No. plants	Condition	Threats
23a. Mundijong	Swan Coastal	Serpentine-Jarrahdale	Freehold	Private property	Landholders	1990 2005	3 fl 0	Habitat intact, orchid not present	Owner is keen conservationist. Large area of bush present in good condition; only part of it is suitable habitat. <ul style="list-style-type: none"> • Inappropriate fire • Poor recruitment
23b. Mundijong	Swan Coastal	Serpentine-Jarrahdale	Freehold	Private property	Landholders	1990 2005	2 veg 0	Habitat intact, orchid not present	Owner is keen conservationist. Large area of bush present in good condition; only part of it is suitable habitat. <ul style="list-style-type: none"> • Inappropriate fire • Poor recruitment
24. Mundijong	Swan Coastal	Serpentine-Jarrahdale	Freehold	Private property	Landholders	1990 2005	6 veg 0	Habitat intact, orchid not present	Owner is keen conservationist. Large area of bush present in good condition; only part of it is suitable habitat. <ul style="list-style-type: none"> • Inappropriate fire • Poor recruitment
25. Busselton	Blackwood	Busselton	Freehold	Private property (Mining Lease)	Landholders, Iluka Resources Ltd	1996 1997 2004 2005	200+ # 100+ # 200+ # ca 75 #	Moderate	<ul style="list-style-type: none"> • Grazing and disturbance by cattle, kangaroos and rabbits • Rising salinity • Active <i>Phytophthora cinnamomi</i> presence • Inappropriate fire • Poor recruitment
26. Australind	Wellington	Harvey	Minister for Transport	Road reserve	Main Roads Western Australia	1996 1997 1998 1999 2000 2001	2 # 0 0 0 0 0	Presumed Extinct	Both plants were transplanted as part of road construction work in December 1996. This was monitored annually for five years; no plants seen.
27. Boyanup	Wellington	Capel	Conservation Commission of Western Australia	State Forest	DEC	1997 2000 2007	11 # 0 4 fl, 6 veg	Moderate	<ul style="list-style-type: none"> • Grazing and disturbance by rabbits and kangaroos • Recreational use of area • Small-scale sand extraction • Inappropriate fire • Poor recruitment

Recovery Plan for *Drakaea elastica*

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Manager	Year	No. plants	Condition	Threats
28. Capel	Blackwood	Capel	Freehold	Private property	Landholders	2005	12 #	Healthy	<ul style="list-style-type: none"> • Clearing – housing development • Inappropriate fire
29. Jandakot	Swan Coastal	Cockburn	Commonwealth Government	Airport	Jandakot Airport Holdings Ltd.	2005	4 veg	Healthy	<ul style="list-style-type: none"> • Clearing – commercial development • Inappropriate fire • Poor recruitment
30. Mundijong	Swan Coastal	Serpentine-Jarrahdale	Freehold	Private property	Landholders	2005	10 fl, 8 veg	Healthy	<ul style="list-style-type: none"> • Clearing – gas pipeline construction • Gas pipeline maintenance • Grazing and disturbance by rabbits and kangaroos • Weed presence • Inappropriate fire • Poor recruitment
31. Wandii	Swan Coastal	Kwinana	Freehold	Private property	Landholders	2005	4 fl	Healthy	<ul style="list-style-type: none"> • Clearing – housing • Inappropriate fire • Poor recruitment
32. SW of Pinjarra	Swan Coastal	Murray	Freehold	Private property	Landholders	2005	14 veg	Healthy	<ul style="list-style-type: none"> • Inappropriate fire • Poor recruitment
33a. SW of Pinjarra	Swan Coastal	Murray	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	2005	1 veg	Healthy	<ul style="list-style-type: none"> • Inappropriate fire • Poor recruitment
33b. SW of Pinjarra	Swan Coastal	Murray	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	2005	3 veg	Healthy	<ul style="list-style-type: none"> • Inappropriate fire • Poor recruitment
34. Gingin	Swan Coastal	Gingin	Conservation Commission of Western Australia	State Forest	DEC	2005	2 fl, 12 veg	Healthy	<ul style="list-style-type: none"> • Inappropriate fire • Poor recruitment
35. Binningup	Wellington	Harvey	Freehold	Private property	Landholders	2006	1 fl, 1 veg	Healthy	<ul style="list-style-type: none"> • Inappropriate fire • Poor recruitment
36a. Stake Hill	Swan Coastal	Murray	Freehold	Private property	Landholders	2006	31 #	Healthy	<ul style="list-style-type: none"> • Lack of supporting habitat • Inappropriate fire • Poor recruitment
						2007	72 #		

Recovery Plan for *Drakaea elastica*

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Manager	Year	No. plants	Condition	Threats
36b. Stake Hill	Swan Coastal	Murray	Commissioner for Main Roads	Road reserve	Main Roads Western Australia	2006 2007	10 # 220 #	Healthy	<ul style="list-style-type: none"> • Clearing – roadworks proposed • Inappropriate fire • Poor recruitment
37a. Stake Hill	Swan Coastal	Murray	Commissioner for Main Roads	Road reserve	Main Roads Western Australia	2006 2007	1 fl, 2 veg 3 fl, 6 veg	Healthy	<ul style="list-style-type: none"> • Clearing – roadworks proposed • Inappropriate fire • Poor recruitment
37b. Stake Hill	Swan Coastal	Rockingham	Freehold (Western Australian Planning Commission)	Regional Park	DEC	2006 2007	27 fl, 108 veg 2551 #	Healthy	<ul style="list-style-type: none"> • Clearing – roadworks proposed • Inappropriate fire
38. Stake Hill	Swan Coastal	Murray	Commissioner for Main Roads	Road reserve	Main Roads Western Australia	2006 2007	2 fl, 1 veg 0	Extinct	Cleared – roadworks
39. Capel	Blackwood	Capel	Freehold	Private property (Mining Lease)	Landholders, Iluka Resources Ltd	2006	51 fl, 131 veg	Healthy	<p>Large area of bush present, plants scattered across.</p> <ul style="list-style-type: none"> • Inappropriate fire
40. N of Gingin	Swan Coastal	Gingin	Conservation Commission of Western Australia	National Park	DEC	2007	1 #	Moderate	<ul style="list-style-type: none"> • Inappropriate fire • Poor recruitment
41. Gingin	Swan Coastal	Gingin	Conservation Commission of Western Australia	State Forest	DEC	2007	8 fl, 12 veg	Healthy	<ul style="list-style-type: none"> • Impacts from nearby carpark • Inappropriate fire • Poor recruitment
42a. Serpentine	Swan Coastal	Murray	Freehold (Western Australian Planning Commission)	Private property	Western Australian Planning Commission	2007	45 fl, 238 veg	Healthy	<ul style="list-style-type: none"> • Clearing – roadworks proposed • Weed invasion • Rubbish dumping • Inappropriate fire
42b. Serpentine	Swan Coastal	Murray	Conservation Commission of Western Australia	Conservation of Flora and Fauna	DEC	2007	13 fl, 106 veg	Healthy	<ul style="list-style-type: none"> • Weed invasion • Rubbish dumping • Inappropriate fire

Population total represents a mix of flowering (mature) and vegetative (immature) plants. Only mature plants can be considered when applying IUCN criteria.

Fl = flowering plants; veg = vegetative plants.

* = total for all subpopulations combined.

Guide for decision-makers

The above table provides details of current and possible future threats. Proposed actions in the immediate vicinity of populations or within the defined habitat critical to the survival of *Drakaea elastica* require assessment for the potential for a significant level of impact.

Habitat critical to the survival of the species, and important populations

Habitat critical to the survival of the species includes the area of occupancy of important populations; areas of similar habitat surrounding important populations (i.e. low-lying areas of deep sand supporting banksia (*Banksia menziesii*, *B. attenuata* and *B. ilicifolia*) woodland or spearwood (*Kunzea glabrescens*) thicket), as these areas provide potential habitat for natural range extension and are likely to be necessary to support the pollinating wasp and allow pollinators to move between populations; and additional occurrences of similar habitat that may contain important populations of the species or be suitable sites for future translocations or other recovery actions intended to create important populations.

Given that this species is listed as Endangered (EPBC Act), it is considered that all known habitat for wild and translocated populations is habitat critical to its survival, and that all wild and translocated populations are important populations.

Benefits to other species or ecological communities

Caladenia huegelii (DRF under the Wildlife Conservation Act, and ranked as Critically Endangered in WA and listed as Endangered under EPBC Act) occurs at the same site as Population 29 of *Drakaea elastica*. *Drakaea micrantha* (DRF under the Wildlife Conservation Act, and ranked as Endangered in WA and listed as Vulnerable under EPBC Act) occurs at the same site as Population 35 of *Drakaea elastica*. Recovery actions that protect *Drakaea elastica* will also protect these rare flora species and the ecological community in which they and *D. elastica* are located.

International obligations

This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that Convention. *Drakaea elastica* is listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), ratified by Australia in July 1976. The aim of that convention is to ensure that international trade in listed species does not threaten their survival (UNEP-WCMC 2007).

Indigenous consultation

Involvement of the Indigenous community is being sought through the indigenous reference groups for the Northern Agricultural Catchment Council, Swan Catchment Council and South West Catchment Council to determine whether there are any issues or interests identified in the plan. A search of the Department of Indigenous Affairs' Aboriginal Heritage Sites Register has identified a number of sites in the area of *Drakaea elastica* populations.

Summary of populations co-occurring with sites listed on the Register of Aboriginal Sites

Population No.	DEC District	Site ID	Site Name	Site Type	Additional Information
9	Perth Hills	3928	Moonda Brook		Camp
23, 24, 30, 36, 37 and 38	Swan Coastal	3582	Serpentine River	Ceremonial, Mythological	
36, 37 and 38	Swan Coastal	3595	Serpentine River		Plant Resource
33	Swan Coastal	3686	Nine Mile Lake	Mythological	
35	Wellington	5807	Harvey 55/ Brunswick Jun. Rd	Artefacts / Scatter	Camp, [Other: ?]
11 – subject to population boundaries	Wellington	5809	Brunswick Junction 57	Artefacts / Scatter	Camp, [Other: ?]
11 - subject to population boundaries	Wellington	5810	Brunswick Junction 58	Artefacts / Scatter	Camp, [Other: ?]

Where no role is identified for the indigenous community associated with this species in the development of the recovery plan, opportunities may exist through cultural interpretation and awareness of the species. Indigenous involvement in the implementation of recovery actions will be encouraged.

The advice of the relevant NRM indigenous reference groups is being sought to assist in the identification of cultural values for land occupied by threatened species, or groups with a cultural connection to land that is important for the species' conservation. Continued liaison between DEC and the indigenous community will identify areas in which collaboration will assist implementation of recovery actions.

The Indigenous Natural Resource Management Advisory Group (INRMAG) of the Swan Catchment Council has been consulted and subsequently has had the opportunity to provide culturally appropriate input into this recovery plan. Where registered sites co-occur with *Drakaea elastica*, specific advice has been sought. (INRMAG 2007).

The INRMAG recognises that DEC, through the Recovery Plan process, seeks to conserve and protect areas of natural remnant vegetation. The INRMAG recognise that together we share similar goals of seeking to manage these areas for conservation and seek to include and support Aboriginal interest and involvement in the management and planning processes (INRMAG 2007).

Social and economic impacts

Proposed land developments which are likely to impact on populations of declared rare flora listed under the Wildlife Conservation Act, or threatened flora listed under the EPBC Act, are subject to environmental impact assessment under those Acts, or the State *Environmental Protection Act 1986*. The outcome of such assessments may require avoidance, reduction or mitigation of potential impacts on the listed flora, and where impacts are permitted, the implementation of environmental offsets. These outcomes have potential social and economic impacts.

Some populations are located on private property and in areas leased for mining activities, their management may potentially affect farming and mining activities. Recovery actions will involve liaison and cooperation with all stakeholders with regard to these areas.

Affected interests

Stakeholders potentially affected by the implementation of this plan include:

- Private property owners of land on or near where the species occurs;
- Main Roads Western Australia ;
- Southern Gateway Alliance (Main Roads WA);
- Iluka Resources Limited;
- Jandakot Airport Holdings;
- Western Power Corporation;
- Alinta Limited;
- Shire of Capel;
- Shire of Harvey;
- City of Armadale; and
- DEC.

Evaluation of the plan's performance

DEC will evaluate the performance of this recovery plan in conjunction with the Swan and South West Region Threatened Flora and Communities Recovery Teams and Moora District Threatened Flora and Communities Recovery Team. In addition to annual reporting on progress with listed actions and comparison against the criteria for success and failure, the plan is to be reviewed within five years of its implementation.

2. RECOVERY OBJECTIVE AND CRITERIA

Objective

The objective of this recovery plan is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term preservation of the species in the wild.

Criteria for success: The total number of mature (flowering) plants and/or the area of occupancy is maintained over the five year term of the plan.

Criteria for failure: The total number of mature (flowering) plants and/or the area of occupancy has decreased over the five year term of the plan.

3. RECOVERY ACTIONS

Completed recovery actions

Relevant land managers have been notified of the location and threatened status of the species. The notification details the Declared Rare status of *Drakaea elastica* and associated legal obligations. Ongoing liaison occurs between DEC and relevant land managers to ensure protection of populations.

An information sheet has been prepared that includes a description of *Drakaea elastica*, its habitat, threats, recovery actions and photos of the species. The information sheet will be distributed to community members through local libraries, wildflower shows and other methods. It is hoped that the information sheet will result in the discovery of new populations, and raise community awareness of the value of native flora.

Staff from relevant DEC Districts and Regions regularly monitor all populations of this species.

Surveys for this species were undertaken in 2005 and 2006, with several new populations found as a result. The discovery of new populations in areas not previously known to contain *Drakaea elastica* indicates that there is a strong possibility of finding new populations through further survey.

Fencing has been erected at Population 18 to protect plants from vertebrate grazers, as buds were being taken before plants could flower and set seed. An area with a high density of *Drakaea elastica* plants is protected by a fence erected in February 2005. This fence also protects the associated habitat from grazing and trampling. Other more scattered plants have received protection from smaller rabbit-netting enclosures erected by the landholder during 2006. While this fencing has reduced grazing of buds, some are still being lost. This is thought to be due to invertebrate grazers.

A number of strategic infrastructure projects have impacted populations of *Drakaea elastica*. Where this has occurred, plants of *Drakaea elastica* which would have been destroyed were salvaged and used to trial translocation of the species, and for other research purposes.

Roadworks necessitated the taking of both known plants at Population 26 and a salvage attempt was made in December 1996. The plants were moved by heavy machinery to an area approximately 15 m away. A large amount of soil supporting the *Drakaea* plants was moved with them. Annual monitoring for five years and occasional monitoring in following years has failed to record any plants over a period of ten years.

In a salvage attempt (Population 30) five plants were moved a short distance from the construction zone in February 2006 while the plants were dormant. Other plants in the population remained undisturbed. The plants were moved by heavy machinery with the surrounding soil. Monitoring will be undertaken in the 2008 flowering season.

Approval was given to take all three plants from Population 38 and a salvage attempt was made in March 2007. These plants have been kept at the Botanic Gardens and Parks Authority (BGPA) nursery and it is hoped that they may be sustained *ex situ*, perhaps offering further information about the species. Liaison is continuing to minimise the impacts of construction on two other populations of *Drakaea elastica* (Populations 36 and 37). Any plants that will be taken by construction are also to be salvaged by BGPA and kept at the nursery for

research purposes. In the future a detailed translocation plan may be developed with the benefit of research results.

Attempts to propagate *Drakaea elastica* have been unsuccessful. Although germination of *Drakaea* seed has been achieved, plants have died when transferred into pots. *Drakaea* plants dug up in the wild and transferred into pots typically live 2-4 years at best.

Hand-pollination of plants at Population 18 and Subpopulation 37b was undertaken in September 2006 to guarantee production of seed needed for research. Fruit set in *Drakaea* appears to be mostly limited by a lack of natural pollination, as hand pollination generally results in successful fruit set.

A total of 0.25 ml of seed was collected from hand-pollinated plants. This represents many thousands of seeds with preliminary tests showing the seed to be viable and easily germinated. A portion of this seed will be used for research into the mycorrhizal ecology of *Drakaea elastica*. The rest will be put into long-term storage at BGPA and Kew Gardens as part of the Millennium Seed Bank Project.

The fungus associated with *Drakaea elastica* has been isolated and is known to successfully germinate *D. elastica* seed. The fungus will be DNA sequenced to help identify how many strains are efficacious. Strains of the fungus found to be effective will be introduced into long-term storage at the BGPA. Whether this fungus is shared with other *Drakaea* species will be investigated, as will the abundance of the mycorrhiza in the field and whether it is associated with any particular microhabitat. Field sites containing mycorrhiza that may be suitable for translocation will be identified.

Ongoing and future recovery actions

Collections have been made of the pollinating wasp which is believed to be an undescribed species of thynnid. Preliminary studies of the wasp were undertaken in spring 2006 with early results suggesting that it is most common in areas of banksia woodland with spearwood present. It should be noted that the dataset will be significantly added to over the next two years. Initial results suggest that the wasp is common near Busselton and scarce around Capel. The wasp has not been recorded from sites on the Leeuwin – Naturaliste Ridge, tuart forest or remnant bushland on the southern or eastern side of the Peel-Harvey estuary. Interestingly, no wasps were recorded in the habitat of Population 13, although natural fruit-set has been observed. The northern end of *Drakaea elastica*'s range is yet to be studied. Ongoing research work will identify the habitat requirements of the pollinator, the presence of pollinators in other areas of suitable habitat, any differences in habitat preferences between the orchid and the pollinator, the rarity of the pollinator, whether the pollinator is affected by habitat fragmentation and whether the pollination rate is limiting the abundance of *D. elastica*.

The Swan and South West Region Threatened Flora and Communities Recovery Teams and Moora District Threatened Flora and Communities Recovery Team are overseeing the implementation of this recovery plan and will include information on progress in their annual reports to DEC's Corporate Executive and funding bodies.

Where populations occur on lands other than those managed by DEC, permission has been or will be sought from appropriate land managers prior to recovery actions being undertaken. The following recovery actions are roughly in order of descending priority, influenced by their timing over the term of the Plan. However this should not constrain addressing any of the priorities if funding is available for 'lower' priorities and other opportunities arise.

1. Coordinate recovery actions

The Swan and South West Region and Moora District Threatened Flora and Communities Recovery Teams will coordinate recovery actions for *Drakaea elastica* and other Declared Rare Flora in their jurisdictions. They will include information on progress in their annual reports to DEC's Corporate Executive and funding bodies.

Action:	Coordinate recovery actions
Responsibility:	DEC (Swan Region, South West Region and Moora District) through Recovery Teams
Cost:	\$5,000 per year

2. Liaise with appropriate stakeholders

Staff from DEC's Moora District, Swan Region and South West Region will continue to liaise with relevant land managers, landowners and Indigenous groups to ensure that populations are not accidentally damaged or destroyed. A number of significant sites that occur in the vicinity of *Drakaea elastica* are listed on the Aboriginal Sites Register maintained by the Department of Indigenous Affairs. The custodians of these areas will be identified, and their input and involvement will be sought in the management of populations in this area.

Action: Liaise with appropriate stakeholders
Responsibility: DEC (Swan Region, South West Region and Moora District) through Recovery Teams
Cost: \$3,500 per year

3. Reduce impact of grazing on seed production

Grazing by rabbits (*Oryctolagus cuniculus*) and kangaroos (*Macropus fuliginosus*) threatens seed production at several populations of *Drakaea elastica*. Methods of controlling grazing will be investigated and a control strategy will be developed and implemented. This may involve fencing clusters of plants within larger fenced areas of vegetation. It is thought invertebrate herbivores may also be impacting on recruitment of this species. Consideration will be given to installation of fine mesh enclosures over clusters of flowering *D. elastica* plants. If implemented it will exclude pollinators and hand pollination orchid flowers will be undertaken.

Action: Reduce impact of grazing on seed production
Responsibility: DEC (Swan Region and South West Region) through Recovery Teams
Cost: \$6,600 per year in years 1, 3 and 5

4. Negotiate agreements that protect *D. elastica* and habitat

Negotiations should recognise the need to retain as much natural habitat as possible to support the pollinating thynnid wasp.

This will also be applied to any new populations, particularly those that occur within intact and ecologically functioning vegetation. Any possibility of reserving populations in large areas of vegetation should be actively pursued.

Action: Negotiate agreements that protect *D. elastica* and habitat
Responsibility: DEC (Swan Region, South West Region, Species and Communities Branch) through the SRTFCRT and SWRTFCRT
Cost: \$5,100 in year 1

5. Undertake hand-pollination

In some smaller areas of habitat it seems likely that pollinators may be absent or present only in small numbers. Hand-pollination will be undertaken to facilitate production and dispersal of seed, and may lead to recruitment of new individuals.

Action: Undertake hand-pollination
Responsibility: DEC (Swan Region, South West Region and Moora District) and BGPA (Science) through Recovery Teams
Cost: \$1,500 per year

6. Collect and store seed

Seed should be stored as a genetic resource for future translocations and to provide an ex-situ conservation collection for the species. Hand-pollination is an efficient way to ensure pollination and collect seed. Some seed should be collected and stored, with the majority left on the plant to allow for natural germination and recruitment *in situ*. Detailed information on where seed was collected should be recorded and made available to

appropriate stakeholders. The Threatened Flora Seed Centre usually collect a voucher specimen to support the identification of source plants, but little material will be available at the time of seed collection as the single leaf will have withered. In lieu of this, a photo taken at the time of hand-pollination may be useful. This seed will be collected by DEC staff and stored by BGPA, as they have specific expertise with orchids and appropriate storage facilities. Some seed has been collected from Population 18 and Subpopulation 37b but additional collections are required from these and other populations to maintain adequate representation of the genetic diversity of the species. Only a small percentage of available flowers should be pollinated and collected from in any one season, as pollination of most flowers in a population is likely to reduce flowering and seed set in the following year/s. The "Germplasm Conservation Guidelines for Australia" produced by the Australian Network for Plant Conservation (ANPC) should be used to guide this process (Offord & Meagher 2009).

Action:	Collect and store seed
Responsibility:	DEC (Swan Region, South West Region and Moora District) and BGPA (Science) through the Recovery Teams
Cost:	\$3,900 per year

7. Monitor populations

Extant populations will be monitored at least every two years. Where habitat is still extant, presumed extinct populations should be monitored approximately four-yearly or during good seasons (as determined from the outcome of other monitoring activity). If no plants are recorded during regular monitoring for twenty years, the population should be formally considered extinct.

Monitoring and surveys need to be undertaken at an appropriate time of year, preferably between June and August when the leaf is fresh and glossy, or if necessary when in flower (September-early October). Monitoring of factors such as habitat degradation (including weed invasion, salinity and plant diseases such as *Phytophthora cinnamomi*), number of flowering and vegetative plants present, population stability (expansion or decline), pollinator activity and seed production if evident (September-November), recruitment, longevity and predation is essential. Populations 9, 11 and 27 urgently require monitoring to assess current status and threats. Wherever possible, an accurate locational fix of individual plants will be captured using a differential global positioning system. This information makes it possible to respond more accurately to fire events and facilitates the tracking of population demographics. Useful in all populations, it is particularly helpful in large and/or scattered populations such as Populations 13, 14, 15, 16, 17, 18, 20, 25 and Subpopulation 37b. The habitat of Population 4 is in poor condition, but there is potential habitat on the other side of the drain bisecting this reserve that warrants further survey.

Action:	Monitor populations
Responsibility:	DEC (Swan Region, South West Region and Moora District) through Recovery Teams
Cost:	\$6,400 per year in years 1, 3 and 5

8. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Drakaea elastica* is essential to provide a sound scientific basis for its management in the wild. An understanding of the following is necessary for effective management:

1. Pollination ecology – the role of the pollinator in causing rarity in *D. elastica*; fruit set rates of *D. elastica* in comparison to more common *Drakaea* species; the effect of population size on fruit set; the abundance/rarity of the pollinator; the habitat requirements of the pollinator; the ability of viable populations of the pollinator to survive in small remnant areas of bushland; and if the pollinator is rare, techniques to breed it in captivity.
2. Mycorrhizal ecology - the role of the mycorrhiza in causing rarity in *D. elastica*; comparison of recruitment rates in *D. elastica* and more common *Drakaea* species; the abundance/rarity of the mycorrhiza; the habitat requirements of the mycorrhiza; the type/s of mycorrhiza *D. elastica* associates with.
3. Population genetics – the natural level of genetic variability within populations of *D. elastica*; the natural level of genetic variability between populations of *D. elastica*; clonality of *D. elastica*; and levels of genetic differentiation between populations of *D. elastica*.

4. *Ex situ* conservation and propagation – longevity of individual plants; requirements of the mycorrhizal fungi for growing *D. elastica* in cultivation; techniques for the growth and survival of *D. elastica* in the laboratory, the nursery and the field site; and techniques to store *D. elastica* tissue material and seed and fungus material in the middle to long term.
5. Other factors affecting recruitment - role of various disturbances (including fire and physical opening of canopy), competition, rainfall and grazing in germination and recruitment of *D. elastica* and on the health of its mycorrhizal fungus.
6. Specific factors limiting recruitment at Populations 14, 15, 22, 23 and 24, where plant numbers are declining although the habitat appears to be intact. (Limited at seed production/seed germination/seedling survival stage? Linked to rainfall/fungus/pollinator/other?).

Quadrats have been established in Population 13, and have provided some useful demographic and autecological information (Carstairs and Coates 1994). These should continue to be monitored biannually. Similar plots could be set up at Population 18. Botanic Gardens and Parks Authority (BGPA) scientists will be involved in this research as they have expertise in the area of orchid conservation research.

Action: Obtain biological and ecological information
Responsibility: DEC (Science Division, Swan Region, South West Region and Moora District) and BGPA through the Recovery Teams
Cost: \$68,000 per year in years 1, 2 and 3; \$60,000 per year in years 4 and 5

9. Implement weed control

The current threat from weeds is low. However, if weeds are seen to be encroaching on extant populations, control will be undertaken before they invade the areas where plants occur. Special attention will be paid to recently burnt populations to prevent weeds becoming established before habitat regenerates. Weed control will be undertaken in consultation with relevant land managers. It will involve localised application of herbicide during the appropriate season, or physical weed removal in situations where the resulting ground disturbance is minor and is not in close proximity to *Drakaea elastica* plants. Effort will be made to minimise the effect of herbicide on native vegetation, including use of wick rather than spray application. The method, timing and success of any weed control, and the effect on *D. elastica* and associated native plant species will be documented. Records will be kept at the District, Region and Species and Communities Branch.

Action: Implement weed control
Responsibility: DEC (Swan Region and South West Region) through Recovery Teams
Cost: \$3,200 per year in years 1, 3 and 5

10. Develop and implement a fire management strategy

This species is not affected by fire during its summer dormant phase when all live plant tissue is below ground. However, between late April and early November when plants are actively growing or flowering, the species is vulnerable to fire. If the plant has not had sufficient time to develop a new tuber it will be killed. Too-frequent fire will also compromise the health and change the form of supporting vegetation, facilitate the proliferation of weed species, and reduce or massively increase the canopy cover which *D. elastica* requires. However, occasional fire may promote health of this species by reducing competition from other vegetation for space, and provide a source of nutrients for the growth of mycorrhizal fungi (Carstairs and Coates 1994). Fire should therefore be prevented from occurring in the area of populations, except where it is being used as a management tool. A fire management strategy will be developed in consultation with land managers, and will include recommendations on prescription fire frequency and intensity; precautions to prevent fire; a strategy for reacting to wild fire; and the need, placement and maintenance of firebreaks.

Action: Develop and implement a fire management strategy
Responsibility: DEC (Swan Region, South West Region and Moora District) with relevant land managers through Recovery Teams
Cost: \$9,600 in year 1; \$6,600 per year in years 2, 3, 4 and 5

11. Develop and implement a *Phytophthora* strategy

Phytophthora cinnamomi has been identified in the vicinity of Population 25. This infestation should be mapped and the information used to develop and implement an appropriate control strategy. This may involve aerial phosphite spraying, ideally coordinated with spraying of other threatened or priority flora in the area. The presence of *Phytophthora* near Population 13 should be tested. If it is confirmed to be present, a control strategy should also be developed and implemented at this site.

Action: Develop and implement a *Phytophthora* strategy
Responsibility: DEC (South West Region and Swan Region) through Recovery Teams
Cost: \$5,800 year 1; \$7,300 year 2; \$7,300 year 3; \$8,800 year 4; \$7,300 year 5

12. Conduct further surveys

Further surveys by DEC staff and community volunteers will be conducted when the leaf of *Drakaea elastica* is bright and glossy (June-August), or if necessary when in flower (September-early October). If funding becomes available it would be desirable to conduct extensive surveys of a range of areas of appropriate habitat. The 2006 discovery of Populations 36 and 37 in an area where *D. elastica* was not previously recorded indicates that continued survey in new areas is warranted. Emphasis should be placed on larger areas of habitat that have a greater chance of naturally functioning ecological processes. Any areas of suitable habitat with adequate protection should also be noted as potential future translocation sites. Records of areas surveyed will be sent to Species and Communities Branch and retained at appropriate Districts and Regions, even if *D. elastica* is not found.

Action: Conduct further surveys
Responsibility: DEC (Swan Region, South West Region and Moora District) through Recovery Teams
Cost: \$6,700 per year in years 1, 3 and 5

13. Develop and implement best practice protocols for translocations

Techniques are not currently well established to keep salvaged plants alive *ex situ* or to translocate them to a suitable site if available. Development of techniques is recommended in Recovery Action 8, and once developed will enable greater numbers of *Drakaea elastica* plants grown from seed or tissue culture to be translocated with their associated fungus. Any translocation projects will be guided by the *Guidelines for the translocation of threatened plants in Australia*, produced by the ANPC (Vallee et al. 2004).

Action: Develop and implement best practice protocols for translocations
Responsibility: DEC (relevant District/Region) and BGPA through the Recovery Teams
Cost: \$2000 per year in years 2 and 4

14. Promote awareness

The importance of biodiversity conservation and the need for the long-term protection of wild populations of this species will be promoted to the community through poster displays and the local print and electronic media. Formal links with local naturalist groups and interested individuals will also be encouraged. An information sheet will be produced, and will include a description of the plant, its habitat, threats, recovery actions and photos. This will be distributed to the public through all relevant DEC Regional and District offices and at the offices and libraries of relevant Shires. Such information distribution may lead to the discovery of new populations.

Action: Promote awareness
Responsibility: DEC (Swan Region, South West Region and Moora District) through Recovery Teams
Cost: \$1,800 in year 1; \$1,200 per year in years 2, 3, 4 and 5

15. Map habitat critical to survival

Although habitat critical is described in Section 1, the areas as described have not yet been mapped and that will be redressed under this action. If any additional populations are located, then this habitat will also be determined and mapped for these locations.

Action: Map habitat critical to survival
Responsibility: DEC (Swan Region, South West Region and Moora District) through Recovery Teams
Cost: \$4,900 in year 1

16. Review the Plan

At the end of the five-year term of this recovery plan, the plan will be reviewed and the need for further recovery actions assessed.

Action: Review the Plan
Responsibility: DEC (SCB, Swan Region, South West Region, Moora District) through Recovery Teams
Cost: \$4,500 in the fifth year

Summary of Recovery Actions

Recovery Actions	Priority	Responsibility	Completion date
Coordinate recovery actions	High	DEC (Swan Region, South West Region and Moora District) through Recovery Teams	Ongoing
Liaise with appropriate stakeholders	High	DEC (Swan Region, South West Region and Moora District) through Recovery Teams	Ongoing
Reduce impact of grazing on seed production	High	DEC (Swan Region and South West Region) through Recovery Teams	2013
Negotiate agreements that protect <i>D. elastica</i> and habitat	High	DEC (Swan Region, Species and Communities Branch) through the SRTFCRT	2009
Undertake hand-pollination	High	DEC (Swan Region, South West Region and Moora District) and BGPA (Science) through Recovery Teams	Ongoing
Collect and store seed	High	DEC (Swan Region, South West Region and Moora District) and BGPA (Science)	2013
Monitor populations	High	DEC (Swan Region, South West Region and Moora District) through Recovery Teams	2008 & ongoing
Obtain biological and ecological information	High	DEC (Science Division, Swan Region, South West Region and Moora District) and BGPA through the Recovery Teams	2013
Implement weed control	Medium	DEC (Swan Region and South West Region) through Recovery Teams	2013
Develop and implement a fire management strategy	Medium	DEC (Swan Region, South West Region and Moora District) with relevant land managers	2013
Develop and implement a <i>Phytophthora</i> strategy	Medium	DEC (South West Region and Swan Region) through Recovery Teams	2013
Conduct further surveys	Medium	DEC (Swan Region, South West Region and Moora District) through Recovery Teams	2013
Develop best practice protocols for translocations	Medium	DEC (relevant District/Region) and BGPA through the Recovery Teams	2012
Promote awareness	Low	DEC (Swan Region, South West Region and Moora District) through Recovery Teams	2013
Map habitat critical to survival	Low	DEC (Swan Region, South West Region and Moora District) through Recovery Teams	2009
Review the Plan	Low	DEC (SCB, Swan Region, South West Region, Moora District) through Recovery Teams	2013

4. TERM OF PLAN

Western Australia

This Interim Recovery Plan will operate from April 2008 to March 2013 but will remain in force until withdrawn or replaced. If the taxon is still ranked as Endangered after five years, this IRP will be reviewed and if necessary, further recovery actions put in place.

Commonwealth

In accordance with the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) this adopted recovery plan will remain in force until revoked.

The recovery plan must be reviewed at intervals of not longer than 5 years.

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6. TAXONOMIC DESCRIPTION

Excerpt from: Hopper, S.D. and Brown, A.P. (2007) A revision of Australia's hammer orchids (*Drakaea*: Orchidaceae), with some field data on species-specific sexually-deceived wasp pollinators. *Australian Systematic Botany* 20, 1–34.

Drakaea elastica

Leaf often withered at anthesis, glabrous; lamina conspicuously glossy, light green with slightly darker venation above, to 20mm wide. Scape 12–30 cm tall; pedicels 10–12mm long. Dorsal sepal 12–15mm long. Lateral sepals 12–14mm long. Petals 12–14mm long. Labellum claw distal section beyond hinge held straight in line with proximal section, without prominent dark spots; labellum lamina 10–12mm long, articulated at *c.* 70° to distal arm of claw; head-like apex one-third of lamina length, prominently hirsute for 0.9× its length, lacking paired lateral dark maroon callosities at base; main labellum body two-coloured, hirsute on lower part of proximal half of inflated section, proximal half greenish-yellow with a few maroon spots and irregular markings, moderately inflated, apex straight. Column 8–10mm long; wings 1.5mm wide. Anther not terminating in a definite mucronate point

SUMMARY OF RECOVERY ACTIONS AND COSTS

Recovery Action	Year 1			Year 2			Year 3			Year 4			Year 5		
	DEC	Other	Ext.	DEC	Other	Ext.	DEC	Other	Ext.	DEC	Other	Ext.	DEC	Other	Ext.
Coordinate recovery actions	3,600	1,100	300	3,600	1,100	300	3,600	1,100	300	3,600	1,100	300	3,600	1,100	300
Liaise with stakeholders	2,700		800	2,700		800	2,700		800	2,700		800	2,700		800
Reduce impact of grazing on seed production	2,400		4,200				2,400		4,200				2,400		4,200
Negotiate agreements that protect <i>D. elastica</i> and habitat	4,800		300												
Undertake hand pollination	900		600	900		600	900		600	900		600	900		600
Collect and store seed	900	1,800	1,200	900	1,800	1,200	900	1,800	1,200	900	1,800	1,200	900	1,800	1,200
Monitor populations	4,500		1,900				4,500		1,900				4,500		1,900
Obtain biological and ecological information		68,000			68,000			68,000		10,000		50,000	10,000		50,000
Implement weed control	1,800		1,400				1,800		1,400				1,800		1,400
Develop and implement a fire management strategy	4,500	3,200	1,900	3,300	1,400	1,900	3,300	1,400	1,900	3,300	1,400	1,900	3,300	1,400	1,900
Develop and implement a phytophthora strategy	3,000	900	1,900	1,800	900	4,600	1,800	900	4,600	3,000	900	4,900	1,800	900	4,600
Conduct further surveys	4,800		1,900				4,800		1,900				4,800		1,900
Develop best practice protocols for translocations				2,000						2,000					
Promote awareness	1,200		600	1,200			1,200			1,200			1,200		
Map habitat critical to survival	3,600		1,300												
Review the Plan													4 500		
Total	43,200	75,000	18,300	16,400	73,200	9,400	27,900	73,200	18,800	27,600	5,200	59,700	37,900	5,200	68,800
Yearly Total	136,500			99,000			119,900			92,500			111,900		

Ext. = External funding (funding to be sought), Other = funds contributed by MRWA, in-kind contribution and BGPA.

Total DEC: \$153,000
 Total Other: \$231,800
 Total External Funding: \$175,000
Total Costs: \$559,800