# Recovery Plan for
# *Graptophyllum reticulatum*

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Australian Government

Queensland Government
Environmental Protection Agency
Queensland Parks and Wildlife Service

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# Contents

# Executive Summary


**Species description**
*Graptophyllum reticulatum*, commonly known as reticulated holly or veiny graptophyllum, is a slow-growing, understorey shrub belonging to the diverse family, Acanthaceae. Four *Graptophyllum* species are native to Australia and are restricted to the coastal regions of eastern Queensland.

**Current species status**
*Graptophyllum reticulatum* is listed as nationally 'Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and as 'Endangered' on the Queensland *Nature Conservation Act 1992* (NCA).

**Habitat and distribution summary**
*G. reticulatum* is a rainforest species that is restricted to lowland subtropical rainforest, particularly in complex notophyll vine forest mixed with tall to very tall closed forest and riparian rainforest. Remnants of this vegetation type (lowland subtropical rainforest) at low elevations (between 100-120m) on rocky, basalt soils are essential habitat for this species. The plant grows in creek-lines and gullies on the upper slopes of olivine basalt caps, near the edge of escarpments. The species is also known to occur in disturbed areas with rainforest or pasture and *Acacia melanoxylon* regrowth adjacent to complex notophyll vine forest. *G. reticulatum* is endemic to south-east Queensland, being entirely restricted to the Maroochy Shire Council local government area. The species is known from three populations in the wild of which two occur on protected land. Estimates of the total population size of *G. reticulatum* vary, ranging between 800-1500 individuals.

**Threats summary**
Urban development, weeds and the potential for fire and other disturbance are all threats to *G. reticulatum* populations. The urban development surrounding the Buderim population increases the additional risks of land slips, hydrological changes and associated nutrient pollution, as well as potential hybridisation between *G. reticulatum* and congeners planted in local gardens. In addition, fragmentation and disturbance of native ecosystems may have influenced insect and predator dynamics and caused a decline in the reproductive capacity of the species as there are few reports of seed production for this species.

**Recovery objectives**
The overall objective of this recovery plan is to conserve the known populations of *G. reticulatum* from further decline and to maintain and enhance wild populations in the long-term. The specific objectives of this recovery plan aim to determine the extent of the species distribution, protect known populations through the abatement of key threats, develop research programs that provide knowledge relevant to the species recovery and promote community awareness and involvement in the recovery of *G. reticulatum*.

**Summary of recovery actions**
The recovery actions in this plan relate specifically to the threats identified for *G. reticulatum.* For example, negotiating conservation agreements will secure and protect populations on private land from habitat loss and fragmentation through urban development. Field surveys, maintenance of updated databases and information exchange between land managers will help verify the species distribution. Actions contributing to improved habitat management will enable threats posed by urban development, inappropriate fire regimes and invasive weeds to be addressed. Research projects investigating the ecological requirements, recruitment processes and stability of *G. reticulatum* populations will enhance understanding of the biology and ecology of this species. The development of educational material will increase public awareness and promote responsible behaviour by residents neighbouring bushland remnants.

# 1. General information

## 1.1 Background information

The genus *Graptophyllum* is a member of the diverse family Acanthaceae Juss, which mainly occurs in tropical and some temperate environments. Globally, there are about 15 species of *Graptophyllum,* comprising shrubs or small trees that predominantly occur in the Pacific region and West Africa (Barker 1986). The five species that occur in Australia are concentrated in the subtropics and tropics and are restricted to eastern coastal Queensland (Barker 1986, Hnatiuk 1990). However, only four of these species are likely to be native. The fifth species, *G. pictum* (L.) Griff., is common and native to New Guinea and Melanesia (Henderson 2002) and, although collected in the far north Queensland Pastoral District of Cook (Hnatiuk 1990), is likely to have been introduced into northern Australia (Barker 1986).

## 1.2 Conservation status

*Graptophyllum reticulatum* is listed as nationally 'Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and as 'Endangered' on the Queensland *Nature Conservation Act 1992* (NCA).

## 1.3 International obligations

The species is not listed under any international agreements and this recovery plan is consistent with Australia's international obligations.

## 1.4 Affected interests

*G. reticulatum* occurs on lands owned and managed by the State and Local Governments and by private persons. The implementation of this recovery plan may affect and require involvement from the following stakeholders:

- Queensland Environmental Protection Agency/Queensland Parks and Wildlife Service (EPA/QPWS).
- Maroochy Shire Council (MSC).
- Natural Resource Management South East Queensland (NRM SEQ Inc.).
- Private landholders on lots containing the species at Buderim.
- Conservation groups, such as Greening Australia, Landcare, Bushcare and others.
- The Society for Growing Australian Plants Queensland.
- Eric Joseph Foote War Memorial Sanctuary Association.
- Other interested community groups.

## 1.5 Consultation with Indigenous people

Three populations of *G. reticulatum* are located in the traditional lands of the Gubbi Gubbi tribal group. Representatives of the Gubbi Gubbi were consulted in the development of this plan however no specific interest in this species was identified. Where appropriate, involvement from indigenous groups in the implementation of this recovery plan will be encouraged.

## 1.6 Benefits to other species or communities

Species of *Graptophyllum* have been used for cultural, medicinal, horticultural and construction purposes, and *G. reticulatum* could be investigated for such socio-economic uses, particularly for pharmaceutical and horticultural products. The habitat occupied by *G. reticulatum* is of high nature conservation value as it has high diversity and contains numerous other threatened species (Section 2.6, Table 1). Implementing the recovery plan will improve the conservation of *G. reticulatum* and other threatened species within these complex notophyll vine forest remnants. It will assist with the conservation of a vegetation type that has been extensively cleared and fragmented in the South-east Queensland Bioregion. It is also of strategic importance as it will enhance the protection and maintenance of biodiversity and consolidate conservation values in the vicinity of Triunia National Park.

### 1.7 Social and economic impacts

It is not expected that the implementation of this recovery plan will have any significant, adverse social or economic impacts in the short or long-term. There are currently three known populations of this species, two of which occur on protected areas. Protection of any populations occurring on private land will be achieved through the negotiation of voluntary conservation agreements.

## 2. Biological information

### 2.1 Species description

*Graptophyllum reticulatum*, commonly known as reticulated holly or veiny graptophyllum, is a slow-growing shrub of 1-2.5m height and 1.5m width. It has opposite, glabrous leaves of 10.5 by 4.5cm, that are darker above than below. The leaves are leathery, and have 5-8 pairs of pungent, 2mm long teeth on the margins with a spine on the leaf-tip. The lateral veins on the leaves are raised in fresh material, hence the species name of 'reticulatum'. The flower corolla is white with mauve spots, as is the flower of *G. spinigerum.* However, the latter has smaller leaves of less than 6cm length. Flowers of *G. reticulatum* are produced between October and December, but the woody capsule fruits are rarely seen (Bean and Sharpe 1991) and were not reported from field observations until 2000 (Shapcott 2000). The full species description can be found in Bean and Sharpe (1991).

### 2.2 Distribution

*G. reticulatum* is endemic to south-east Queensland (Figure 1), being entirely restricted to the South-east Queensland Bioregion, in the Sunshine Coast District, Moreton pastoral district, southern Queensland management region (EPA/QPWS), and the Maroochy Shire Council local government area. *G. reticulatum* occurs within three remnant rainforest patches, approximately 15km apart (Misiak 1998). Two populations are located close together in the Nambour district, while the third occurs on the eastern slopes of Mt. Buderim, farther east on the Sunshine Coast. Location details (i.e. latitude/longitude co-ordinates) for these populations, are provided in a secure appendices.

The two Nambour populations extend over a range of between 11-50km$^2$ (QG and COA 1997). However, they occupy only between 0.45 to 1.2ha, although approximately 20ha has been estimated to be potential habitat (Barry and Thomas 1994, QG and COA 1997).

The first of the Nambour region populations is located on the southern boundary of Triunia National Park (see SOQ 1998), extending into the adjacent Triunia Vegetation Conservation Levy (VCL) council reserve. This area was recently purchased by Maroochy Shire Council with their Environment Levy and is freehold tenure (M. Coyle, pers. comm.).

The second population in this vicinity is located in the Dulong Road Bushland Conservation Reserve (BCR). The Dulong Road BCR is managed by the Parks, Bushland and Open Space (PBOS) branch of Maroochy Shire Council with the primary management intent of biodiversity conservation. Recent reports indicated that this population extends into adjacent freehold land, for which the registration of a Conservation Covenant is underway (R. Shannon, pers. comm.).

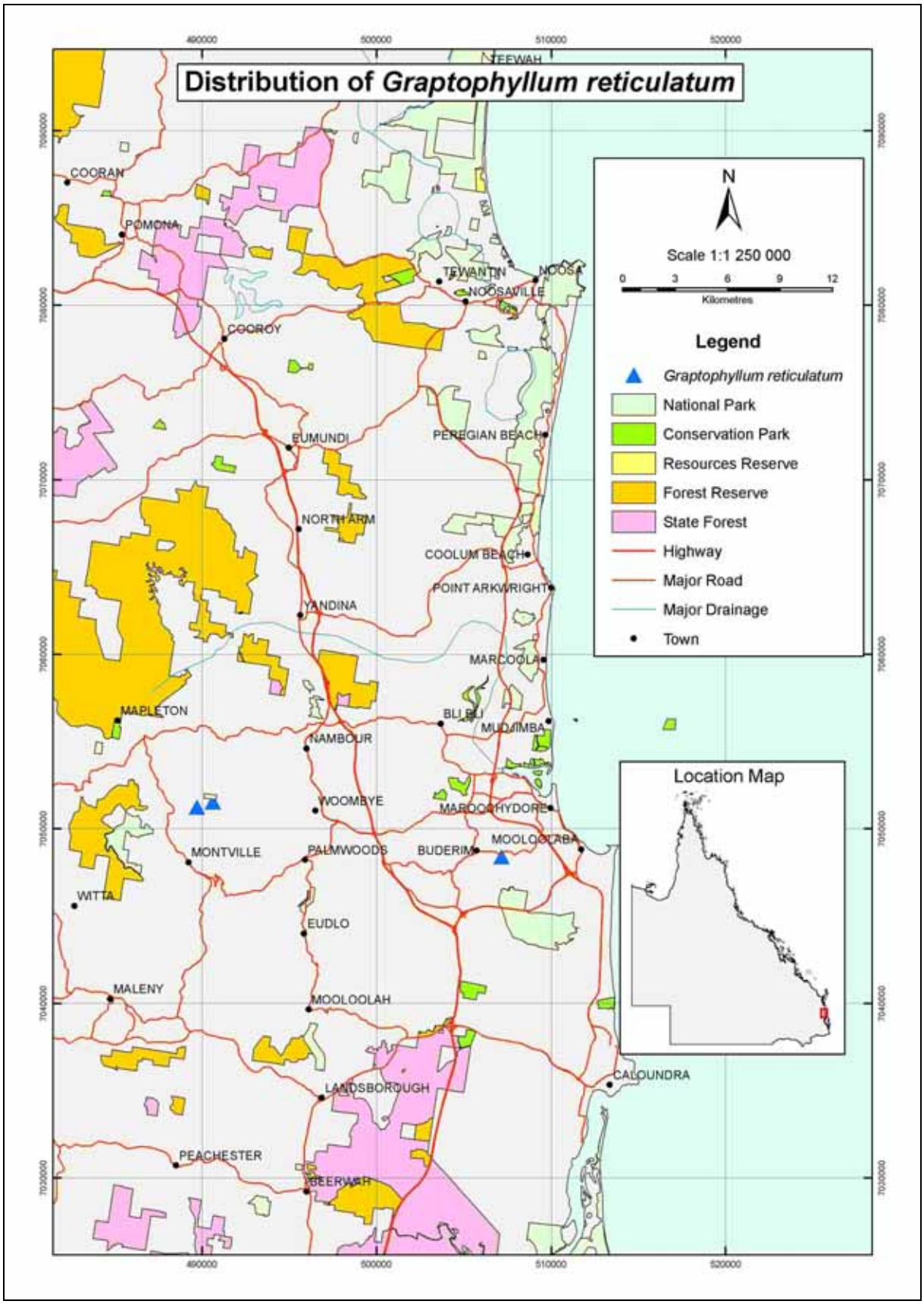


**Figure 1. Distribution of *Graptophyllum reticulatum* sites within south-east Queensland.**

The third population of *G. reticulatum* is located about 2km east of central Buderim, and is distributed across various blocks bounded by Dixon Road, Caroline Crescent, Nyes Crescent and Gwynore Court. The six blocks with extant *G. reticulatum* are either council or privately owned freehold tenure.

An additional mention of the species can be found in the declaration of Tokatakiya Nature Refuge (Queensland Government 2004). However, there are no associated herbarium records and the Nature Refuge is located approximately 115km west of Roma, just north of the Warrego Highway; well away from the known populations of *G. reticulatum.* Vegetation consists of *Acacia harpophylla – Casuarina cristata* woodland – open forest (Queensland Government 2006), which is not known to be suitable habitat for *G. reticulatum.*

Cuttings of plants from the Buderim population have been propagated and established within the Eric Joseph Foote War Memorial Sanctuary (Foote Sanctuary) at Buderim (see Section 3.1; Hansen *et al.* 2003b). Nine *G. reticulatum* plants are also held in the *ex situ* collection of the Australian National Botanic Gardens (ANBG 2005). Commercial nurseries that formerly propagated the plant have stated that they no longer hold stock plants.

### 2.3 Population size

Estimates of the total population of *G. reticulatum* vary considerably. Original estimates were of approximately 200 plants (Barry and Thomas 1994, QG and COA 1997). More recent estimates are of 800-1000 plants (McDonald 2000) or approximately 1500 individuals (Shapcott 2005). These totals represent a maximum as the vigorous suckering capacity of *G. reticulatum* suggests that many of these 'plants' may be clones with common rootstock (McDonald 2000). However, a recent genetics analysis (Shapcott 2005) found little evidence for clonal growth, suggesting that most plants at Buderim are likely to be genetic individuals with localised vegetative spread (A. Shapcott, pers. comm.).

The numbers of *G. reticulatum* plants at the Triunia National Park site have been estimated at 50-100 plants by Barry and Thomas (1994) and as 400 plants by Shapcott (2005). The Dulong Road BCR population was estimated by Barry and Thomas (1994) as 50-100 plants of *G. reticulatum*, and by Shapcott (2005) as 100 plants. However, F. MacIntyre (pers. comm.) estimated this population as only 40-50 plants. The Buderim population of *G. reticulatum* was systematically mapped and estimated by Shapcott (2000) at between 700-1000 plants. However, McDonald (2000) estimated the population as between 475-600 plants, with 375-400 of these on one block and 100-200 plants (or 30-40 percent of the total population) on another block. Hansen *et al.* (2003a), in contrast, suggested that the majority of the plants occurred on the latter block.

### 2.4 Life history and ecology

*G. reticulatum* is a rainforest species. It is restricted to complex notophyll vine forest (subtropical rainforest) of the 'warm' or lowland subtype, that occurs at altitudes of less than 600-700m on the plateaux of the Beechmont, Springbrook, Mt. Tamborine and Maleny-Montville regions (Young and McDonald 1984). The locations average annual rainfall at Mt. Buderim is 1759mm and at Nambour 1692mm, with both having a predominantly (66-69 percent) summer incidence (Elsol and Sattler 1979). The plant grows in creek-lines and gullies on the upper slopes of olivine basalt caps, near the edge of escarpments, and plants are grouped in a clump at the Buderim site (Hansen *et al.* 2003a).

The *G. reticulatum* population in Triunia National Park is located in a fire-protected site in, and between, two ephemeral streams (R. Thomas, pers. comm.). The complex notophyll vine forest is dominated by *Dissiliaria baloghioides* (blackheart)*, Argyrodendron* sp. aff. *trifoliatum, Cryptocarya laevigata* and *Baloghia inophylla* (scrub bloodwood), with *Archontophoenix cunninghamiana* (piccabeen palm)*, Canarium australasicum* (mango bark) and *Cleistanthus cunninghamii* (omega)*.* Vines and epiphytes are numerous. The soil is a thin black loam, rich in organic matter, but rocky in the creek-lines (Misiak 1998).

The nearby Dulong Road BCR site contains complex notophyll vine forest mixed with tall to very tall closed forest and riparian rainforest, similar to the vegetation types at the Triunia National Park site. The area comprises steep, rugged, former farmland with rainforest confined to gullies (F. Macintyre, pers. comm.). *G. reticulatum* is located on rocky creek banks and the adjacent scree slopes, in thin, rocky soils (Barry and Thomas 1994). It occurs in disturbed areas with rainforest or pasture and *Acacia melanoxylon* regrowth adjacent to complex notophyll vine forest (Thomas 2004).

The Buderim population is located on the south-east side of the Buderim Mountain Plateau on the Sunshine Coast. *G. reticulatum* occurs in a significant remnant of a subtropical rainforest that was historically restricted to the upper slopes and summit of Mt. Buderim (McDonald 2000). The notophyll rainforest is classified as Regional Ecosystem 12.8.3 but has distinctive canopy dominants of *Argyrodendron* sp. (Kin Kin) rather than the more widespread *A. trifoliolatum*, *Acacia bakeri, Planchonella queenslandica* and *Grevillea hilliana,* as well as having many floristic elements of Regional Ecosystem 12.11.10 – Araucarian notophyll/microphyll vine forest on metasediments and interbedded volcanics (McDonald 2000). The site has a rocky, basalt substrate (some boulders are up to two metres diameter), underlain by Triassic-Jurassic sandstone, and with gradients of up to 20 degrees (Golder and Associates n.d. cited in COA n.d.). Large vines (up to 10cm girth) and large trees in the vegetation indicate that the rainforest remnant had been of significant age and structural development (McDonald 2000).

After the clearing of part of the Buderim population approximately five years ago, many of the *G. reticulatum* plants have resprouted and fruit and prolific flowering have been observed (Shapcott 2000, Shapcott pers. comm.). Observations of higher levels of flowering by plants in the intact vegetation adjacent to the cleared area were associated with responses to higher light levels (Shapcott pers. comm.).

### 2.5 Habitat critical to the survival of the species

As *G. reticulatum* is restricted to lowland subtropical rainforest at between 100-120m altitude, remnants of this vegetation type at low elevations on rocky, basalt soils are essential habitat for this species. This vegetation type has been extensively cleared and less than 10 percent remains in the South-east Queensland Bioregion (SOQ 1998). It is also the plant community considered to be most at risk on the south-east Queensland coast and only occurs as remnant patches in the Sunshine Coast area (SOQ 1998); a situation likely to be exacerbated by ongoing development in the region.

There are indications that *G. reticulatum* may be naturally rare. The geological and climatic characteristics of the habitat of *G. reticulatum* are rare in south-east Queensland (Elsol and Sattler 1979, Hansen *et al.* 2003a) and have been historically relatively restricted (McDonald 2000). The species occurs in a key centre of plant endemism in south-east Queensland (QG and COA 1998) in a vegetation type with many species that are either at their northern range limit, narrow endemics, or disjunct between south-east and far northern Queensland (Young and McDonald 1984). Furthermore, the *Graptophyllum* genus has a high level of rarity both in Australia and the South Pacific.

### 2.6 Important populations

Due to the low total population size and small number of populations of *G. reticulatum,* all populations of the species are considered important to the survival of the species.

The protection of the *G. reticulatum* population on the boundary of Triunia National Park is important for the conservation of this and other associated species. The national park, although only 17.97ha in area, includes about 300 (mainly rainforest) plant species, 15 of which are listed as of conservation significance. This population is the second largest in size and has the highest ecological integrity. Management regimes sympathetic to conservation of native species is required.

The Buderim population is also important to the conservation of *G. reticulatum.* It is the largest of the three populations, comprising an estimated 80 percent of the total number of individuals, and has the highest level of genetic diversity (Shapcott, in press). There are at least three additional listed threatened species at this site.

The Dulong Road BCR site contains eight threatened species, a subset of those occurring in Triunia National Park. It is also noteworthy due to the limited gene flow between this and the Triunia *G. reticulatum* population. Shapcott (2005) reports that the Dulong Road and Buderim populations are the most genetically similar despite the close geographic proximity of the Triunia and Dulong populations.

Table 1: List of threatened flora species co-occurring with *Graptophyllum reticulatum* and their conservation status under the Qld NCA and the Commonwealth EPBC Act. Symbols: R rare, V vulnerable, E endangered; ♣ species present.

| Species Name | Family | NCA | EPBC Act | Population Locations | | |
|---|---|---|---|---|---|---|
| | | | | Triunia | Dulong | Buderim |
| *Austromyrtus inophloia* | Myrtaceae | R | - | ♣ | ♣ | |
| *Bosistoa transversa* | Rutaceae | V | V | ♣ | ♣ | ♣ |
| *Choricarpia subargentea* | Myrtaceae | R | - | ♣ | ♣ | |
| *Corynocarpus rupestris* ssp. *arborescens* | Corynocarpaceae | R | - | ♣ | ♣ | ♣ |
| *Floydia praealta* | Proteaceae | V | V | ♣ | | |
| *Macadamia integrifolia* | Proteaceae | V | V | ♣ | ♣ | |
| *Macadamia ternifolia* | Proteaceae | V | V | ♣ | ♣ | ♣ |
| *Marsdenia coronata* | Asclepiadaceae | V | V | ♣ | | |
| *Nothoalsomitra suberosa* | Cucurbitaceae | R | - | ♣ | | |
| *Plectranthus omissus* | Lamiaceae | E | E | ♣ | | |
| *Pouteria eerwah* | Sapotaceae | E | E | ♣ | ♣ | |
| *Romnalda strobilacea* | Xanthorrhoeacea | V | V | ♣ | | |
| *Triunia robusta* | Proteaceae | E | E | ♣ | | |
| *Zieria* sp. (Brolga Park.Bean 1002) | Rutaceae | E | E | ♣ | | |

# 3. Threats

### 3.1 Biology and ecology relevant to threats

Studies of the biology and ecology of *Graptophyllum reticulatum* have not been conducted. However, expert opinion on this species was compiled in 1997 (QG and COA 1997). *G. reticulatum* is a slow-growing shrub with a juvenile period estimated at over two years and a lifespan of over 30 years. It regenerates through resprouting and possibly from a short-lived seed bank. Seeds are presumed to have a short-lived viability. Reproductive capacity is presumed to be limited, due to the restricted extent of the populations, the low size of two of the populations, and the probable low level of recruitment. The populations are thought to be declining (Barry and Thomas 1994). The habitat of *G. reticulatum* is specialised and, even though it is of restricted availability, is not fully occupied by the taxon (QG and COA 1997).

The fruit of *G. reticulatum* is a woody, oblong to ovoid capsule. Viable seed has only been recorded by A. Shapcott (2000) and is considered to be not always available (ASGAP 2002). MacIntyre (pers. comm.) reported that no viable seed on the wild plants at Dulong had been observed as seeds tend to be eaten and bored into by insects. Barry and Thomas (1994)

suggest that successful seedling germination and establishment, as well as seed dispersal, may be dependent on irregular climatic triggers such as high rainfall events or seasons. In contrast, garden specimens of *G. ilicifolium* can produce dozens of self-sown seedlings each year (I. Champion, pers. comm.). Dispersal of Acanthaceae seed tends to be localised, dependent on forcible ejection with opening of the capsule (Morley and Toelken 1983). Nevertheless, seed of *G. ilicifolium* can be ejected from the capsule a considerable distance from the parent plant (I. Champion, pers. comm.). Additionally, the stream-bank locations of *G. reticulatum* sites may facilitate downstream dispersal in high rainfall seasons (Barry and Thomas 1994).

The plants themselves are fairly hardy. Mature plants can sucker (McDonald 2000, ASGAP 2002), leading to clonal propagation; aerial stems have been observed to develop roots at Triunia National Park and the plants tend to occur in clumps, supporting the likelihood of vegetative spread (Barry and Thomas 1994). Furthermore, part of the Buderim population was bulldozed in early 2000, yet after an initial yellowing from 'sunburn', has resprouted profusely (B. McDonald, pers. comm.). Damaged plants have been recorded resprouting from stems (C. Critchley, pers. comm.).

Propagation of *G. reticulatum* has been achieved from cuttings by several nurseries in south-east Queensland and by the Australian National Botanic Gardens. These collections represent low numbers of wild plants and are unlikely to be representative of the genetic diversity of the species. Plants have also been cultivated from cuttings and established in the Foote Sanctuary in Buderim (Hansen *et al.* 2003b). The source plants from which the cuttings were taken were tagged (M. Coyle, pers. comm.) and comprise approximately 200 individuals. The surviving 50 plants (in 2005) represent a considerable proportion of the portion of the population for which the harvesting licence was issued, but are not representative of the entire Buderim population of between 475 to 1000 plants.

The population genetics of Queensland's *Graptophyllum* species were investigated by Dr. A. Shapcott, University of the Sunshine Coast (Shapcott 2005), who found:

- All four species have quite high levels of genetic diversity, although *G. reticulatum* has the lowest diversity.
- All species were significantly inbred but *G. reticulatum* was the most inbred.
- Genetic differentiation between populations was highest in *G. reticulatum*.
- The Buderim population of *G. reticulatum* population had higher genetic diversity than the other populations.
- Genetic diversity appears to be correlated with population size.
- Gene flow between populations of *G. reticulatum* is low enough to cause population divergence and loss of allelic diversity due to genetic drift.
- The Dulong Road BCR population and the Buderim population are more similar genetically than either to the Triunia National Park population, despite the geographic proximity of the Dulong and Triunia sites.

### 3.2 Identification of threats

Urban development, weeds and the potential for fire and other disturbance are all threats to *G. reticulatum*. The urban situation of the Buderim population creates the additional risks of hydrological changes and associated nutrient pollution (Hansen *et al.* 2003a) as well as potential hybridisation between *G. reticulatum* and congeners planted in local gardens. Historically, cattle-grazing was a threat to the Dulong Road BCR population (Barry and Thomas 1994). Additionally, fragmentation and disturbance of native ecosystems may have influenced insect and predator dynamics and caused a decline in the reproductive capacity of the species.

### 3.2.1 Urban development

Housing development is a significant threat to the *G. reticulatum* population at Buderim. Several blocks containing *G. reticulatum* have recently been subdivided, although the plants are subject to council environmental covenants, and other blocks are proposed for subdivision or development.

An additional threat associated with development in the Buderim region specifically and the Sunshine Coast in general is the risk of land slips. The Buderim population of *G. reticulatum* is located on rocky, basalt substrates with slopes of up to 20 degrees (Golder and Associates n.d. cited in COA n.d.). Buderim Mountain is one of two main areas within the coastal region east of Yandina to Caboolture that is prone to slope failure (Arup n.d.), and over 70 percent of mapped landslips have occurred on Tertiary basalts, generally on lower bound slope angles of at least 15 percent (MSC 2002). Furthermore, major causes of slope instability include loading of the top of a slip through building or fill deposition, tree clearing and consequent rises in groundwater, and excavation of benches for house sites that removes support at the toe of a slip (Arup n.d.). Thus, the steep slope, soil type, and development mechanism of cutting benches into hillsides on Mt. Buderim with an associated reduction of vegetation extent suggests that there may be a potentially high risk of land slip associated with development of the site. The area of the *G. reticulatum* population has been classified as high to very high landslip hazard, with the plants being located in high hazard areas but downslope of very high hazard areas.

### 3.2.2 Weeds

*Lantana camara, Ageratina riparia* and glycine are the most significant weeds at the Triunia and Dulong Road BCR populations (Barry and Thomas 1994, SOQ 1998). Triunia National Park has a significant weed invasion (SOQ 1998) located upstream of the population, but this is being addressed through the administration of pest initiative funding to control weeds and enhance native regeneration (R. Thomas, pers. comm.). Weeds at the Dulong site have been spread in the past through cattle grazing and trampling (Barry and Thomas 1994).

The Buderim site is also heavily weed-infested, a likely consequence of past and ongoing disturbance and of the establishment of local ‘garden escapes’, i.e. horticultural plants that can disperse and establish beyond garden confines. Most of the weeds occur in the area that was severely disturbed by bulldozing (A. Shapcott, pers. comm.).

Bulldozing of part of the Buderim population in 2000 resulted in profuse growth of exotic vines that may have detrimental effects on the regeneration of native trees and shrubs (McDonald 2000). The various weeds at this site include *Ochna serrulata* (Mickey Mouse bush), *Cinnamomum camphora* (Camphor laurel), *Solanum torvum, Lantana camara, Senna pendula* var. *glabrata,* and the vines *Passiflora* spp. and *Asparagus plumosus* (McDonald 2000). Additionally, *Salvia splendens* (Scarlet salvia) has formed an extensive weed plume in conjunction with an *ad hoc* drain and the associated nutrient pollution. Some bushland regeneration works have been undertaken in relation to Mickey Mouse bush and Scarlet salvia (Hansen *et al.* 2003a).

### 3.2.3 Fire

As a rainforest dependent species, *G. reticulatum* is susceptible to fire. The Triunia population of *G. reticulatum* is, however, in a fire-protected site and is regarded as not requiring current management in relation to fire risk (R. Thomas, pers. comm.). In contrast, the population at Dulong Road BCR may be at risk of fire, although most of the plants are located near a creek (A. Shapcott, pers. comm.) and the Buderim population has a high fire risk associated with its urban location and prior targeted disturbance of the plants.

### 3.2.4 Potential lack of recruitment

Lack of recruitment may threaten the population viability of *G. reticulatum.* There are only a few reports of seed being produced, and those that have been observed have been predated by insects. This predation may be a result of high insect levels related to the fragmentation and small size of rainforest remnants, an effect increasing with the expanding urbanisation of the Sunshine Coast and hinterland. Furthermore, because of the level of inbreeding in *G. reticulatum,* any seed produced may not be viable.

Lack of or minimal seed production could prevent the species from being self-sustaining and exacerbate the level of inbreeding. Additionally, it may prevent dispersal of seed and establishment of a seed bank, resulting in regeneration of *G. reticulatum* being dependent on vegetative resprouting, and limiting the adaptive capacity of the species to environmental and climatic change.

## 3.3 Populations under threat

The Buderim population is highly susceptible to disturbance associated with close proximity of an urban environment, and the potential alteration of understorey conditions detrimental to regeneration of rainforest species. Deliberate attempted destruction of the population has occurred on two occasions, i.e. in 2000 and 2005. Other disturbances are likely to and may already include collateral physical damage to plants and soil and deposition of rubbish and gardening waste. Altered hydrology, soil nutrient, humidity and light conditions as well as increased fire risk, weed invasion and altered insect and predator dynamics may adversely impact on the species.

Further subdivision of the land containing *G. reticulatum* has been proposed. The site also has a high risk of land slips, particularly in association with development. An additional threat to this population is potentially from hybridisation between plants of *G. reticulatum* and its congeners. *G. ilicifolium* and *G. excelsum* are known to cross-pollinate and to produce hybrid plants in a garden environment (I. Champion, pers. comm.). As both of the latter species are commercially available through nurseries, there is a risk of hybridisation between any local garden plantings of them with the *in situ G. reticulatum* plants.

### 3.4 Threats Summary

Table 2: Status of the known *in situ* and established *ex situ G. reticulatum* populations and a summary of known and potential ($^{P}$) threats identified at each site.

**Natural (*in situ*) Populations**

| Site | Population Name | Population Size | Land Tenure | Protection Status | Type of Threat | Current actions to reduce threats |
|---|---|---|---|---|---|---|
| 1 | Triunia National Park | 50-400 | National Park | Protected * | • Weed invasion and competition<br>• Lack of recruitment $^{P}$ | • Weed control (EPA/QPWS) |
| | Triunia Council Reserve (CR) | | Freehold land | Unprotected | | • Negotiating Conservation Agreement |
| 2 | Dulong Road Bushland Conservation Reserve (BCR) | 50-100 | Bushland Conservation Reserve (BCR) | Protected * | • Weed invasion and competition<br>• Small population size $^{P}$<br>• Fire risk $^{P}$<br>• Lack of recruitment $^{P}$ | • Local Law 17 Parks and Reserves<br>• Appointment of MSC Fire Management Officer<br>• Negotiating Conservation Agreement |
| 3 | Buderim | 475-1000 | Freehold land | Unprotected | • Urban development<br>• Land slips<br>• Weed invasion and competition<br>• Fire risk<br>• Habitat degradation<br>• Lack of recruitment<br>• Hybridisation $^{P}$ | • Weed control |

**Established (*ex situ*) Populations**

| Site | Population Name | Population Size | Land Tenure | Protection Status | Type of Threat | Current actions to reduce threats |
|---|---|---|---|---|---|---|
| 1 | Foote Sanctuary | 56 | Freehold land (managed as reserve) | Unprotected | • Small population size<br>• Lack of recruitment | • Interpretational signage<br>• Weed control<br>• Revegetation<br>• Local Law 17 Parks and Reserves |
| 2 | Australian National Botanic Gardens | 9 | Botanic Gardens | Protected | • Small population size $^{P}$ | • Weed control<br>• Monitoring |

Protection status: * Protected under Queensland State legislation, ***** Protected under Local Council Local Law. Coordinates for population locations provided in secure appendices

# 4. Recovery objectives, criteria and actions

### 4.1 Overall objective

The overall objective of this recovery plan is to conserve the known populations of *G. reticulatum* from further decline and disturbance, and to maintain and enhance wild populations in the long-term.

### 4.2 Specific objectives

The specific objectives of this recovery plan are to:

1. Protect, restore or maintain all known and newly located populations.
2. Determine the extent of the species distribution by confirming the species presence in areas of potential habitat.
3. Address the key threats to *G. reticulatum* and any assessable potential threats.
4. Develop research programs that assist with the recovery and conservation of *G. reticulatum.*
5. Promote community awareness and education in relation to *G. reticulatum,* and facilitate community involvement in conservation of this species.

### 4.3 Performance criteria

The criteria for successfully achieving the objectives of the *G. reticulatum* recovery plan will be that:

1. Criteria defining appropriate management requirements for *G. reticulatum* populations are determined and prescribed in population management plans.
2. The number of *G. reticulatum* populations on protected land is increased.
3. Annual monitoring programs are developed and implemented and knowledge of *G. reticulatum* population dynamics is increased.
4. Formal communication channels between land management agencies are established.
5. Population portions on private land are enhanced through plantings (i.e. number of plants and area of extent is increased).
6. Field surveys are conducted in areas of potential habitat and the extent of the species distribution and area of occupancy is determined.
7. Population location records are updated and consistent among land management agencies.
8. Appropriate fire management plans are developed and implemented and the impact of inappropriate fire regimes on *G. reticulatum* populations is reduced.
9. Appropriate weed management plans are developed and implemented and the impact of weed invasion on *G. reticulatum* populations is reduced.
10. Research programs that provide information on population abundances, responses to disturbance, seed production and regeneration processes, and other aspects of the species biology and ecology are established and knowledge gained promotes or enhances the recovery of this species.
11. Public awareness of *G. reticulatum* and involvement of community groups and local and state government agencies in conservation programs for *G. reticulatum* is increased.

# 5. Recovery actions

The actions prescribed in order to achieve the specific objectives (Section 4.2) are detailed for each specific objective.

**Objective 1: Protect, restore or maintain all known and newly located populations.**

**Action 1.1** Ensure that the management requirements for *G. reticulatum* are incorporated into management plans for the populations on state and council land including those within easements.

Rationale: The species' habitat of complex notophyll vine forest is vulnerable to disturbance, particularly in urban environments. All three *G. reticulatum* populations are either partly or wholly located within lands managed by Maroochy Shire Council (MSC). One population is partly within the Triunia National Park and partly in the MSC managed Triunia Vegetation Conservation Levy (VCL) reserve. The second population is in the MSC managed Dulong Road Bushland Conservation Reserve. The third population is partly on MSC land and partly on freehold at Buderim. Most of the *G. reticulatum* plants on freehold land are protected by Environmental Covenants or Vegetation Protection Orders. An additional site containing five plants was located in October 2005 on freehold land at Buderim; W. Flenady, pers. comm.).

Potential contributors: Maroochy Shire Council (MSC), EPA/QPWS, Natural Resource Management South east Queensland (NRM SEQ Inc.)

Estimated cost: Planning, site assessment and document development costs - $500 per site. Total estimated cost - $1500.

**Action 1.2** Negotiate conservation agreements for all freehold land blocks containing *G. reticulatum* plants at Buderim.

Rationale: Fragmentation from increasing urbanisation may have detrimental effects on ecosystem processes. Isolation within urban development may change local climatic and environmental conditions, lead to increased levels of disturbance, and imbalances in the ecosystem i.e. predation of seed may prevent recruitment. Protection of the essential habitat of *G. reticulatum* may reduce these effects and enhance natural corridors. Linkage of population fragments, including small numbers of isolated plants, contributes to the viability of populations and to facilitating variation within the species. Accordingly, all portions of *G. reticulatum* populations contribute to the conservation of the species and require protection.

Two freehold tenure blocks underlying and adjacent to the main part of the Buderim *G. reticulatum* population have strategic conservation importance. A Vegetation Protection Order is in place on the smaller block, whilst a development application has been lodged for the adjacent property. Conservation agreements that increase landholder awareness of the significance of populations and secure the protection of *G. reticulatum* habitat on private land, could be negotiated for these properties. Options for landholders include Nature Refuges, which are administered by EPA/QPWS under the *Nature Conservation Act 1992*. Landholders are provided with practical management advice through EPA/QPWS Extension Officers and financial incentives such as Transfer Duty and Land Tax reimbursements through the NatureAssist program, to encourage the protection of natural assets on private property. Voluntary Conservation Agreements may also be negotiated with Local Councils under the *Queensland Land Title Act 1994*. Alternatively, consideration could be given to purchase of these blocks under the MSC Vegetation Conservation Levy (VCL).

Annual monitoring and reporting of assessments (Action 1.3), and the development and implementation of management plans to protect biodiversity values may also assist the

species' recovery. New sites of *G. reticulatum*, such as that located in October 2005, can be incorporated as located into local and state government databases (Action 2.2) and conservation planning.

Potential contributors: MSC, EPA/QPWS, private landholders, Natural Resource Management South east Queensland (NRM SEQ Inc.).

Estimated cost: Negotiation of Conservation Agreements - salary for one staff officer over a six-month period - $26,000. Annual monitoring and reporting costs covered under of Action 1.3. Costs for developing and implementing a site management plan, to be determined.

**Action 1.3** Annually monitor all populations and any plants protected under conservation agreements to assess their demographic stability.

Rationale: The long-term stability of the populations of *G. reticulatum* is dependent on the maintenance of the condition and integrity of the remnant vegetation in which they occur, as well as on the continuation of the natural demographic processes of the species, i.e. on seed production and germination, and seedling establishment. Monitoring of the populations twice yearly or at least on annual intervals, preferably towards the end of the fruiting season, could be recorded, assessed and analyses distributed amongst the interested parties. This action is of particular importance for the Buderim population, which has been subject to repeated attempted destruction.

Potential contributors: EPA/QPWS, MSC, NRM SEQ Inc. Eric Joseph Foote War Memorial Sanctuary Association (Foote Sanctuary Association).

Estimated cost: Monitoring events and site inspections every six months. Allow 2.5 days a year for fieldwork and report writing - $2500 a year, total cost for five years - $12,500.

**Action 1.4** Facilitate information exchange between land management agencies for locations, conditions and threats to threatened species within Maroochy Shire.

Rationale: In order for all agencies to meet their legislative obligations for threatened species and to ensure that best management practices are in place for *G. reticulatum*, relevant information on locations, population condition and threats could be exchanged as updated to nominated environmental personnel. Information exchange and updating between members of the recovery team will also assist implementation of this plan.

Potential contributors: EPA/QPWS, MSC, NRM SEQ Inc.

Estimated cost: No direct costs envisaged, apart from existing operational costs.

**Action 1.5** Enhancement of fragmentary clusters of plants at Buderim through planting of seedlings propagated from seed of local plants.

Rationale: Portions of the Buderim population of *G. reticulatum* are located on freehold residential lots. Although the plants are protected as part of environmental covenants, their low number and isolation from the main part of the population suggests a low long-term viability. The viability of these clusters could be enhanced through the addition of plants propagated from seed of *G. reticulatum* from this area. The use of seed rather than cuttings (i.e. clonal material) is recommended to maintain the ongoing, local ecological relationships of *G. reticulatum* and intra-population genetic diversity. However, as insects predate on *G. reticulatum* seeds, collection of sufficient seed may be dependent on collection

procedures being conducted prior to primary dispersal. For example, direct pollination and exclusion bags that catch seeds from dehisced pods and protect these from insects could be used. Implementation of this Action would take place only after the *G. reticulatum* habitat had been rehabilitated and was deemed able to support additional plantings. Information obtained from propagation trials will compliment investigations undertaken in Action 4.3.

As taking and use of protected plants for conservation/revegetation projects is regulated under the *Nature Conservation Act 1992* (NCA), a licence, permit or authority from the EPA/QPWS to propagate *G. reticulatum* will be required. Contact the EPA/QPWS Ecoaccess Customer Service Unit for further information.

Potential contributors: MSC, Educational institutions such as Nambour TAFE, Conservation organisations such as Greening Australia, EPA/QPWS, NRM SEQ Inc., private landholders.

Estimated cost: Allow 18 months for establishment, planting out and maintenance of *ex situ* population (~500 plants). Total estimated cost - $2200.

**Objective 2: Determine the extent of the species distribution by confirming the species presence or absence in areas of potential habitat.**

**Action 2.1** Conduct systematic search for further populations in complex notophyll vine forest remnants on the Sunshine Coast.

Rationale: Despite the high human population levels and extensive agriculture, forestry and conservation related activities in near-coastal south-east Queensland, *G. reticulatum* was neither collected nor described until recently (1989, 1991 respectively). Its specialised habitat and relatively small, clumped populations suggest that other populations may exist in the Maroochy-Nambour region, as evidenced by the location of five additional plants at Buderim in October 2005. Accordingly, a systematic search of the potential habitat of creek-lines or closed canopy, high humidity/water availability environments on basalt-derived soils in complex notophyll vine forest may prove fruitful in locating additional sites. Analysis of GIS databases, aerial photographs and Regional Ecosystem mapping would assist identification of areas of potential habitat for targeted field surveys.

Potential contributors: EPA/QPWS, MSC, NRM SEQ Inc, private landholders.

Estimated cost: Field surveys (3 days), data compilation and report writing (1 day) – $1250. Database assessment costs - one staff officer's salary for one week - $1080. Total - $ 2330.

**Action 2.2** Update EPA and council records to incorporate precise locational data.

Rationale: Species records databases should be updated as new information is gained and so that precise, extant site records can be distinguished from imprecise records or populations that are known to no longer exist.

Potential contributors: EPA/QPWS, MSC, NRM SEQ Inc.

Estimated cost: Staff officer time for two days per year, for five years. Total cost - $2160.

**Objective 3: Address the key threats to *G. reticulatum* and any assessable, potential threats.**

**Action 3.1** Develop and implement fire management strategy for all populations.

Rationale: The Queensland Parks and Wildlife Service (QPWS) has a Statement of Fire Management Intent for Triunia National Park which refers specifically to management of the subtropical rainforest habitat of *G. reticulatum.* Similarly, for MSC, specific objectives and actions in relation to the fire susceptibility of *G. reticulatum* could be incorporated into regional and urban fire management strategies, allied with precise locational references for population locations and boundaries (Action 4.1). MSC's capability to plan and manage fire for biodiversity and risk management outcomes has increased through the recent appointment of a Fire Management Officer (M. Coyle pers. comm.).

Potential contributors: EPA/QPWS, MSC (Fire Officer and Contractors), NRM SEQ Inc.

Estimated cost: Planning, site assessment and fire management plan development - $500 a site (four sites). Total cost - $2000. Additional costs expected for MSC operational budget.

**Action 3.2** Implement weed management strategy for all populations.

Rationale: Weeds are a significant threat to all populations. Those in Triunia National Park are being addressed through pest initiative funding. Other properties may require additional assessment of the type, extent and appropriate management means to remove all weeds, as well as implementation of control measures.

As there is a need for appropriately qualified staff to achieve conservation outcomes in sensitive areas, groups such as Landcare and NRM groups may be able to advise private landholders of the best management options for weeds on their properties where these are affecting *G. reticulatum* plants and habitat. Those properties subject to environmental covenants that require annual monitoring of the condition of the *G. reticulatum* plants could incorporate disturbance assessments and intervention as part of the assessments.

The Buderim population has an extensive weed plume established in an overland drainage line with high pH and nutrient levels (Hansen *et al.* 2003a). Redirection of the drain run-off and removal of weeds (Hansen *et al.* 2003a) would reduce this threat to this population.

Potential contributors: EPA/QPWS, MSC, NRM SEQ Inc., private landholders.

Estimated cost: Costs dependent on the extent of infestation and type of weed species. Allow $7680 a year for first three years and $3,840 a year in following two years. Total cost – $30, 720. Monitoring costs covered under Action 1.3.

**Action 3.3** Assess disturbance levels at the Buderim population and incorporate results into a monitoring program to assess management effectiveness.

Rationale: Further to Action 1.3, additional information could be recorded on the condition of habitat as well as the levels and causes of disturbance in the remnants relevant to *G. reticulatum* plants. This information would contribute to assessments of the viability of the populations and to the development of site-specific work plans should management be required.

Potential contributors: EPA/QPWS, MSC, NRM SEQ Inc., Foote Sanctuary Association

Estimated cost: Costs for this action are covered as part of Action 1.3.

**Objective 4: Develop research programs that assist with the recovery and conservation of *G. reticulatum.***

**Action 4.1** Undertake field surveys to assess and map the precise location and extent of all populations, the number of plants, and vegetation and environmental characteristics.

Rationale: Precise locational records of the *G. reticulatum* populations and their boundaries are essential to the species' successful conservation and management. This information is also critical for the provision of advice for development assessments within the geographic range of the species. A more thorough knowledge of the number of plants in each population (and on each block), and their habitat will enable appropriate management actions to be implemented successfully. Mapping *G. reticulatum* populations and habitat will require the use of Lot and Plan information, population location and GIS data for site-specific applicability and use; Regional Ecosystem mapping and prior knowledge of the species distribution and preferred habitat.

This work could form the initial assessment of an Honours research project into the distribution, ecology and threats to *G. reticulatum.* The project could also include research into the regeneration of the species (Action 4.3) and of the stability and long-term viability of each population (Action 4.4).

Potential contributors: Educational institutions, NRM SEQ Inc., MSC, EPA/QPWS, private landholders.

Estimated cost: Field support and laboratory analysis. Total estimated cost - $2000.

**Action 4.2** Research habitat characteristics such as the moisture and light requirements of the species as well as the response of *G. reticulatum* to physical disturbances.

Rationale: Understanding of the habitat preferences and biology (e.g. responses to high light levels, nutrient deficiencies, drought) of *G. reticulatum* is essential to its ongoing conservation and management. Preliminary work on the physiology of this species indicates that *G. reticulatum* is more vulnerable to high light levels and that it has a lower capacity for recovery from photo-inhibition than its congeners. Additionally, the vigorous response (albeit after initial 'sunburn') of the species to severe physical disturbance and loss of the vegetation over-storey suggests that the species may have some level of tolerance to more extreme conditions.

Research on these aspects of the ecology of *G. reticulatum* is being conducted as part of a PhD study at the University of Queensland. The study includes measurement of the response of the four Australian species of *Graptophyllum* to high light levels, nutrient deficiencies and to drought.

Potential contributors: Educational institutions eg University of Queensland.

Estimated cost: No external costs are envisaged, apart from existing costs.

**Action 4.3** Research factors affecting the species recruitment processes e.g. levels of seed production, predation, viability, dispersal and germination requirements, pollination biology.

Rationale: *G. reticulatum* has not been observed to produce viable seed and those that have been produced, have been predated by insects. All Australian species of *Graptophyllum* are genetically inbred, and *G. reticulatum* particularly so. Any seed produced may not be viable or the level of production may be insufficient to maintain long-term replacement of old

individuals. Investigation into the levels of seed viability, production, predation, dispersal and the regeneration requirements of this species are needed to indicate whether the populations are sexually reproducing and able to disperse or are limited to vegetative (clonal), local reproduction. Vegetative reproduction may make the species more susceptible to threatening processes and with less adaptive potential to environmental and climatic changes. The risk of hybridisation between *G. reticulatum* and its congeners could also be investigated due to the potential of this occurrence in urban locations.

Potential contributors: Educational institutions, NRM SEQ Inc.

Estimated cost: Field support and laboratory analysis. Estimate: $2000.

**Action 4.4** Assess population stability and long-term viability of each population.

Rationale: The recovery of *G. reticulatum* is dependent on an understanding of the habitat, demography, and evolutionary development and potential of the species. Information on these factors could be analysed using population viability analysis.

Potential contributors: Educational institutions, NRM SEQ Inc.

Estimated cost: Consultation and reporting. Estimate: $2000.

**Objective 5: Promote community awareness and education in relation to *G. reticulatum,* and facilitate community involvement in conservation of the species.**

**Action 5.1** Develop promotional/ interpretive materials relating to the species and rainforest remnants and promoting responsible behaviour by residents neighbouring bushland habitats.

Rationale: An interpretive brochure and web-based fact sheet containing informative material on the description, habitat, conservation status and threats of *G. reticulatum* could be produced in a similar format to that created on the endangered *Acacia porcata.* In addition, the status and conservation value of and threats posed to, remnant rainforest in the region could be included. For example, information on the prevalence of weeds that originate from local gardens in bushland remnants and the impacts of human activities such as waste disposal, illegal clearing and arson on native habitat would be useful for addressing the threats to this species. Inclusion of a photograph or line drawing of the species may facilitate recognition of the plant and lead to reporting of any 'new' populations or sites.

The brochure and web-based fact sheet would enhance community awareness of *G. reticulatum,* of rainforest remnants and their suite of threatened species, and some of the regional environmental significance of the Nambour – Maroochy districts. The brochure may also contribute to increased community involvement in and appreciation for local community groups, such as the Eric Joseph Foote War Memorial Sanctuary Association and the Society for Growing Australian Plants. Recognition of community achievements in relation to on-ground bushland conservation outcomes will be important for encouraging on-going support and for promoting community involvement in threatened species recovery.

Potential contributors: EPA/QPWS, MSC, NRM SEQ Inc.

Estimated cost: Four page colour brochure (5000 copies), total cost - $3708. No cost envisaged for EPA/QPWS web-based fact sheet.

**Action 5.2** Confer with local community group on ‘adopting’ and sub-managing the Buderim council sites.

Rationale: Involvement of the local community in a hands-on conservation project may increase community awareness and education of the value of threatened species and of local endemics, as well as the value of ‘green space’ in urban environments. The Eric Joseph Foote War Memorial Sanctuary Association could be an initial coordinating forum for coordinating locals interested in volunteering on such a project. Liaison with local schools, youth groups and senior citizen associations may also be productive in creating interest in small park management and threatened species issues. The Maroochy Shire Council already has an ‘Adopt a Park’ program to maintain ongoing bushland regeneration works.

Potential contributors: MSC, Foote Sanctuary Association, Conservation organisations (i.e. Greening Australia, Landcare, Bushcare, SGAP), community groups and schools.

Estimated cost: Site maintenance/equipment costs, unable to be determined at this stage.

## Summary of Objectives, Performance Criteria and Actions

**Table 3: Summary of relationships between specific objectives, performance criteria and recovery actions.**

Abbreviations: EPA/QPWS – Queensland Government Environmental Protection Agency/Queensland Parks and Wildlife Service, MSC – Maroochy Shire Council, NRM SEQ Inc. – Natural Resource Management South-east Queensland, Foote Sanctuary Association - Eric Joseph Foote War Memorial Sanctuary Association.

| Specific objectives | Performance criteria | Recovery action | Potential contributors | Priority |
|---|---|---|---|---|
| **Objective 1** Protect, restore or maintain all known and newly located populations. | **Criterion 1.1** Criteria defining appropriate management requirements *G. reticulatum* populations are determined and prescribed in population management plans . | **Action 1.1** Ensure that the management requirements of *G. reticulatum* are incorporated into management plans for the populations on state and council land including those within easements. | MSC, EPA/QPWS, NRM SEQ Inc. | **1** |
| | **Criterion 1.2** The number of *G. reticulatum* populations on protected land is increased. | **Action 1.2** Negotiate conservation agreements for all freehold land blocks containing *G. reticulatum* plants at Buderim. | MSC, private landholders, NRM SEQ Inc. | **1** |
| | **Criterion 1.3** Annual monitoring programs are developed and implemented and knowledge of *G. reticulatum* population dynamics is increased. | **Action 1.3** Annually monitor all populations and any plants protected under conservation agreements to assess their stability. | EPA/QPWS, MSC, NRM SEQ Inc., Foote Sanctuary Association | **1** |
| | **Criterion 1.4** Formal communication channels between land management agencies are established.. | **Action 1.4** Facilitate information exchange between land management agencies in relation to locations, conditions and threats to threatened species within Maroochy Shire. | NRM SEQ Inc., MSC, EPA/QPWS | **1** |
| | **Criterion 1.5** Population portions on private land are enhanced through plantings (i.e. number of plants and area of extent is increased). | **Action 1.5** Enhancement of fragmentary clusters of plants at Buderim through planting of seedlings propagated from seed of local plants. | Private landholders, MSC, Educational institutions, EPA/QPWS, NRM SEQ Inc., conservation organisations | **2** |
| **Objective 2** Determine the extent of the species distribution by confirming the species presence or absence in areas of potential habitat.. | **Criterion 2.1** Field surveys are conducted in areas of potential habitat and the extent of the species distribution and area of occupancy determined.. | **Action 2.1** Conduct systematic search for further populations in complex notophyll vine forest remnants within the Maroochy Shire. | MSC, EPA/QPWS, NRM SEQ Inc., private landholders | **1** |
| | **Criterion 2.2** Population location records are updated and consistent among land management agencies.. | **Action 2.2** Update EPA and council records to incorporate precise locational data. | MSC, EPA/QPWS, NRM SEQ Inc. | **1** |

| Specific objectives | Performance criteria | Recovery action | Potential contributors | Priority |
|---|---|---|---|---|
| **Objective 3**<br>Address the key threats to *G. reticulatum* and any assessable, potential threats. | **Criterion 3.1**<br>Appropriate fire management plans are developed and implemented and the impact of inappropriate fire regimes on *G. reticulatum* populations is reduced.. | **Action 3.1** Develop and implement fire management strategy for all populations. | MSC, EPA/QPWS, NRM SEQ Inc. | **1** |
| | **Criterion 3.2**<br>Appropriate weed management plans are developed and implemented and the impact of weed invasion on *G. reticulatum* populations is reduced.. | **Action 3.2** Implement weed management strategy for all populations. | Maroochy Shire Council, EPA/QPWS, NRM SEQ Inc., private landholders | **1** |
| | | **Action 3.3** Assess disturbance levels at Buderim population and incorporate results into monitoring program to assess management effectiveness. | MSC, EPA/QPWS, NRM SEQ Inc., Foote Sanctuary Association | **2** |
| **Objective 4**<br>Develop research programs that assist with the recovery and conservation of *G. reticulatum.* | **Criterion 4.1**<br>Research programs that provide information on population abundances, responses to disturbance, seed production and regeneration processes, and other aspects of the species biology and ecology are established and knowledge gained promotes or enhances the recovery of this species. | **Action 4.1** Undertake field surveys to assess and map the precise location and extent of all populations, the number of plants, and vegetation and environmental characteristics. | Educational institutions | **1** |
| | | **Action 4.2** Research habitat characteristics such as the moisture and light requirements of the species as well as the response of *G. reticulatum* to physical disturbances. | Educational institutions | **3** |
| | | **Action 4.3** Research factors affecting the species recruitment processes e.g. levels of seed production, predation, viability, dispersal and germination requirements, pollination biology. | Educational institutions, NRM SEQ Inc. | **2** |
| | | **Action 4.4** Assess population stability and long-term viability of each population. | Educational institutions, NRM SEQ Inc. | **1** |
| **Objective 5**<br>Promote community awareness and education in relation to *G. reticulatum,* and facilitate community involvement in conservation of this species. | **Criterion 5.1**<br>Public awareness of *G. reticulatum* and involvement of community groups and local and state government agencies in conservation programs for *G. reticulatum* is increased.. | **Action 5.1** Develop promotional/ interpretive materials relating to the species and rainforest remnants and promoting responsible behaviour by residents neighbouring bushland habitats. | MSC, EPA/QPWS, NRM SEQ Inc. | **2** |
| | | **Action 5.2** Confer with local community group on 'adopting' and sub-managing the Buderim council sites. | MSC, Foote Sanctuary Association, conservation organisations, local community groups, educational institutions | **2** |

## 6. Duration of recovery plan and estimated costs

This recovery plan has a five-year timeframe. Estimated costs are provided in Table 4. Additional costs are expected in relation to actions that are currently unable to be quantified (*); No direct costs envisaged (-).

**Table 4: Estimated budget requirement for *G. reticulatum* recovery plan.**

| Action no. | Action description | Cost estimates ($) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Total |
| 1 | Ensure that the management requirements of *G. reticulatum* are incorporated into management plans for the populations on state and council land including those within easements. | 1,500 | * | * | * | * | 1,500 |
| 2 | Negotiate conservation agreements for all freehold land blocks containing *G. reticulatum* plants at Buderim. | 26,000 | - | - | - | - | 26,000 |
| 3 | Annually monitor all populations and any plants protected under conservation agreements to assess their stability. | 2,500 | 2,500 | 2,500 | 2,500 | 2,500 | 12,500 |
| 4 | Facilitate information exchange between land management agencies in relation to locations, conditions and threats to threatened species within Maroochy Shire. | - | - | - | - | - | - |
| 5 | Enhancement of fragmentary clusters of plants at Buderim through planting of seedlings propagated from seed of local plants. | - | 2,200 | - | - | - | 2,200 |
| 6 | Conduct systematic search for further populations in complex notophyll vine forest remnants within the Maroochy Shire. | 2,330 | - | - | - | - | 2,330 |
| 7 | Update EPA and council records to incorporate precise locational data. | 432 | 432 | 432 | 432 | 432 | 2,160 |
| 8 | Develop and implement fire management strategy for all populations. | - | 2,000 | - | - | - | 2,000 |
| 9 | Implement weed management strategy for all populations. | 7,680 | 7,680 | 7,680 | 3,840 | 3,840 | 30,720 |
| 10 | Assess disturbance levels at Buderim population and incorporate results into monitoring program to assess management effectiveness. | - | - | - | - | - | - |

| Action no. | Action description | Cost estimates ($) | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5** | **Total** |
| 11 | Undertake field surveys to assess and map the precise location and extent of all populations, the number of plants, and vegetation and environmental characteristics. | 2,000 | - | - | - | - | 2,000 |
| 12 | Research habitat characteristics such as the moisture and light requirements of the species as well as the response of *G. reticulatum* to physical disturbances. | - | - | - | - | - | - |
| 12 | Research factors affecting the species recruitment processes e.g. levels of seed production, predation, viability, dispersal and germination requirements, pollination biology. | 2,000 | - | - | - | - | 2,000 |
| 14 | Assess population stability and long-term viability of each population. | 2,000 | - | - | - | - | 2,000 |
| 15 | Develop promotional/ interpretive materials relating to the species and rainforest remnants and promoting responsible behaviour by residents neighbouring bushland habitats. | 3,708 | - | - | - | - | 3,708 |
| 16 | Confer with local community group on 'adopting' / sub-managing the Buderim council sites. | * | * | * | * | * | * |
| **Total** | | **50,150** | **14, 812** | **10,612** | **6772** | **6772** | **89,118** |

## 7. Management Practices

Appropriate management practices are necessary for the maintenance and protection of *G. reticulatum* habitat and for the long-term persistence of this species. The recommended practices detailed below, are based on current understanding of known threats, the species biology and ecology, and may be modified as knowledge of this species improves.

**Protection of Habitat:**

- Prevent further loss of lowland subtropical rainforest as remnants of this vegetation type at low elevations on rocky, basalt soils are critical to the survival of this species.
- Promote management practices that favour the protection of *G. reticulatum* habitat and encourage natural rainforest processes to ensure continued opportunities for this species.
- Manage the impact of environmental weeds through appropriate control programs, targeting species that thrive along creek lines.
- Prevent further degradation of native vegetation at *G. reticulatum* sites, particularly in urban areas.
- Ensure that any proposed development activity in areas prone to landslip that may lead to land instability and disturbance to the Buderim *G. reticulatum* population, is not permitted.

**Protection of *in situ* populations:**

- Promote management practices that favour the protection of *G. reticulatum* populations *in situ* and encourage natural regenerative processes.
- Prevent illegal destruction to, or removal of, *G. reticulatum* plants.

## 8. Evaluation of the recovery plan

Assessment of the success of proposed management actions against the performance criteria described in Section 5 (Table 3) is essential to ensure the successful recovery of *G. reticulatum*. This will be conducted through annual reviews of the recovery plan in consultation with affected stakeholders. An evaluation of the recovery plan by an independent reviewer, will be conducted five-years after adoption.

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