INTERIM RECOVERY PLAN NO. 237

PAYNTER'S TETRATHECA

(*Tetratheca paynterae* subsp. *paynterae* ms)

INTERIM RECOVERY PLAN

2006-2016

June 2006

Portman Iron Ore Pty Ltd, GPO Box W2017 PERTH WA 6846
and Department of Conservation and Land Management
Species and Communities Branch (SCB)
Kensington

Portman Iron Ore Ltd

Western Botanical

Government of Western Australia

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

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. Note: the Department of 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, always within one year of endorsement of that rank by the Minister.

This IRP will operate from June 2006 to May 2016 but will remain in force until withdrawn or replaced.

A recovery plan for *Tetratheca paynterae* subsp. *paynterae* ms was required by the Minister for the Environment (State) and the Minister for the Environment and Heritage (Commonwealth) under environmental approvals granted to Portman Iron Ore Ltd (Portman) in 2003 for iron ore mining at Windarling and Mt Jackson, north of Southern Cross. The plan will be implemented by Portman Iron Ore Ltd in close consultation with DEC and the Goldfields Region Threatened Flora Recovery Team (GRTFRT).

This IRP was approved by the Director of Nature Conservation on 16 June 2006.

Information in this IRP was accurate at June 2006.

IRP PREPARATION

This IRP was prepared by Geoff Cockerton[1], Andrew Brown[2], Piers Goodman[3] and Vanessa Clarke[4]

[1]Director, Western Botanical, a division of Landcare Holdings Pty Ltd, PO Box 367 Mundaring WA 6073.
[2]Coordinator Threatened Flora, Species and Communities Branch (SCB), DEC, PO Box 51 Wanneroo 6946
[3]Manager Environment, Portman Iron Ore Ltd, GPO Box W2017 Perth 6001
[4]FormerConservation Officer, DEC Goldfields Region

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Dr Ken Atkins	Department of Conservation and Land Management
Dr Penny Butcher	Botanic Gardens and Parks Authority
Ryonen Butcher	University of Western Australia
Dr David Coates	Department of Conservation and Land Management
Rebecca Dillon	Department of Conservation and Land Management
Dr Seigy Krauss	Botanic Gardens and Parks Authority
Brian Moyle	Wildflower Society of W.A, member of Koolyanobbing Project Community Reference Group
Shapelle McNee	Western Botanical
Ray Paynter	Member of Koolyanobbing Project Community Reference Group
Steve Rusbridge	Placer Dome
Dr Colin Yates	Department of Conservation and Land Management

Cover photograph by G.Cockerton.

CITATION

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SUMMARY

Scientific Name:	*Tetratheca paynterae* subsp. *paynterae* ms	**Common Name:**	Paynter's Tetratheca
Family:	Tremandraceae	**Flowering Period:**	All year (in response to rainfall); best between August and December
CALM Region:	Goldfields	**CALM District:**	N/A
Shire:	Yilgarn	**Recovery Team:**	Goldfields Region Threatened Flora Recovery Team (GRTFRT)

Illustrations and/or further information: Nuytsia Volume 10, No. 2. (1995) pp 146 – 149.

Current status: *Tetratheca paynterae* subsp. *paynterae* ms was declared as Rare Flora (as *Tetratheca paynterae*) under the Western Australian *Wildlife Conservation Act 1950* on 17th May 1991 and was ranked as Critically Endangered (CR) in February 2005 under World Conservation Union (IUCN 2000) Red List criterion B1ab(ii,iii,iv) as it is known from one location (two sub-populations) and there is a continuing decline in the area, extent and quality of habitat due to the reduction in the number of mature individuals and potential impact from nearby mining. The subspecies was listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in July 2000.

An initial inventory of the subspecies was conducted in 2000, and identified 2,852 mature individuals in three separate locations on Windarling Range. A subsequent more thorough inventory, conducted by Western Botanical in spring 2003, recorded a total of 7,005 individuals from two areas (the W3 and W5 orebody areas) of which 6951 were mature (Cockerton *et al* 2004). Since the commencement of mining operations in 2004, approximately 1,800 plants have been removed during mine development.

Description: *Tetratheca paynterae* subsp. *paynterae* ms is a small shrub to 0.8 m high x 1.2 m wide with ascending slender stems arising from a stout woody base. Leaves are reduced to small scattered triangular scale leaves to 1.5mm long on mature plants with true leaves only present on new growth and in seedlings. Here they are shortly petiolate elliptical with basal leaves 8 mm long x 4 mm wide. Petals are pink to purple, ovate, to 15 mm long x 8 mm wide. Anthers are dark purple in the basal 3/4 and creamy coloured in the distal portion. Flowers are axillary, pedicellate, decumbent, occurring singly or in small groups at nodes on the mature stems. Fruits are in groups of two (sometimes three) locular, obovate, flattened to 5 mm long, light brown when mature. Fruits dehisce to reveal one to four light brown seeds to 4mm long x 1.5 mm wide with a small white aril. The plant is glabrous, dark green and wiry in appearance. The plant is often seen with dead, trimmed stem tips indicating that it is commonly grazed by local macropods (Euro) where access allows. Two subspecies are currently recognised within the species, with the subsp. *paynterae* ms differing from the subsp. *cremnobata* ms in having leaves that are more pubescent on the upper and lower surfaces, a dense covering of short erect hairs over the ovary and the lower half of the style, brighter yellow tips to the anther tubes and style apex, and wider stem diameters in the flowering region, although there is a large overlap in stem widths between the subspecies (Butcher *et al*. 2001). By contrast, *T. paynterae* subsp. *cremnobata* ms has nearly glabrous leaves, a shiny red ovary with scattered glandular hairs and a small area of short, simple hairs restricted to just below the style, a style which is glabrous or has a few glandular hairs towards the base, and dull mauve-red tipped anther tubes and style apex. The growth habit of *T. paynterae* subsp. *cremnobata* ms is more tangled in appearance and the stems are more slender and branched, particularly in the upper half.

Habitat Requirements: *Tetratheca paynterae* subsp. *paynterae* ms is restricted to Western Australia where it occurs in the Windarling Range near the southern edge of Diemals Station, approximately 160 km north of Southern Cross. In this area it grows within very restricted and specialized habitat of small to moderately sized lateral cracks on the face of outcropping ironstone. The subsp. *cremnobata* ms is found some 10 km to the north east in the Die Hardy Range.

Habitat critical to the survival of the species, and important populations: Given that this taxon is listed as Critically Endangered it is considered that all known habitat supporting the existing population, and any successfully translocated populations, is habitat critical to its survival and that all populations are important populations. The habitat critical to the survival of *Tetratheca paynterae* subsp. *paynterae* ms may also include additional nearby occurrences of similar habitat (outcropping ironstone formations) that do not currently contain the species but may have done so in the past and may be suitable for translocations. Translocation trials will assist in determining whether additional areas of similar habitat are considered critical habitat.

Benefits to other Species/Ecological Communities: Recovery actions implemented to preserve the quality and security of the habitat of *Tetratheca paynterae* subsp. *paynterae* ms will also preserve remnant vegetation in which it is located and supports the Declared Rare Flora (DRF) taxon *Ricinocarpos brevis.*

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. The taxon is not listed under the United Nations Environment Program World Conservation Monitoring Centre (UNEP-WCMC) Convention on International Trade in Endangered Species (CITES). This RP does not affect Australia's obligations under international agreements.

Role and Interests of Indigenous People: There are two registered Native Title claims over the Windarling area that include the habitat, and potential habitat, of *Tetratheca paynterae* subsp. *paynterae* ms. In agreements with Portman Iron Ore Ltd, the claimant groups have recorded a general interest in the environment of the area. There are no registered ethnographic or archaeological sites within the habitat of *Tetratheca paynterae* subsp. *paynterae* ms.

Social and Economic Impacts: The implementation of this Interim Recovery Plan will have some economic impact through Portman funding the development and implementation of this plan and because sections of the population that are protected in accordance with statutory environmental approvals have resulted in restricted access to underlying iron ore deposits. There may also be some social impact associated with the potential acquisition of the Diemals Pastoral Lease by Portman to provide for more secure land tenure over the *Tetratheca paynterae* subsp. *paynterae* ms population. There is also potential for translocation sites to complicate future access to mineral resources.

Evaluation of Plan's Performance: The Department of Conservation and Land Management (CALM), Portman Iron Ore Pty Ltd and the Commonwealth Department of the Environment and Heritage (DEH), in conjunction with the Goldfields Region Threatened Flora Recovery Team (GRTFRT) and the Koolyanobbing Project Community Reference Group will evaluate the performance of this Interim Recovery Plan. In addition to annual reporting on progress and evaluation against the criteria for success and failure, the plan will be reviewed following ten years of implementation.

Existing Recovery Actions: The following recovery actions have been or are currently being implemented –

1. Mining exclusion zones have been imposed in accordance with Ministerial environmental approvals (State - Statement 627, 3 June 2003; Commonwealth – 4 September 2003).
2. Agreement has been reached for the acquisition of Diemals Pastoral Lease to provide for secure conservation tenure over *Tetratheca paynterae* subsp. *paynterae* ms populations. Management of the non-mining areas, that include the *Tetratheca paynterae* subsp. *paynterae* ms populations, by Portman in consultation with CALM are consistent with conservation estate.
3. Approximately 35,000 seeds, collected between September and December 2003 from a section of the population that was to be impacted by mining, have been distributed to CALM, Botanic Gardens and Parks Authority (BGPA) and Portman for research, *ex-situ* storage and translocation trials. A further 7100 seeds (estimated), were collected from the eastern end of the *Tetratheca paynterae* subsp. *paynterae* ms population (i.e. within the area approved for mining) in late 2004 immediately prior to the commencement of mining this section of the ridge.
4. Approximately 2500 cuttings that were collected from approximately 200 plants across the population in the period September to December 2003 have been propagated by BGPA and potted on by Western Flora, with mixed results.
5. A comprehensive, reproducible population census was completed in the period September to December 2003.
6. Studies into the genetic structure of *Tetratheca paynterae*, the abundance, viability and germination of its soil stored seed bank, methods for propagation the taxon from cuttings and its habit description were completed by BGPA and CALM Science Division in 2002.
7. A *Tetratheca paynterae* subsp. *paynterae* ms impact management plan has been developed and approved by DEH in accordance with environmental approvals. This plan provides measures to limit the risk of secondary mining impacts on the species (i.e. inadvertent disturbance, excessive dust deposition, fire impact and weed invasion), and also provides for monitoring to track plant condition. An annual report on implementation was produced in March 2005.
8. A representative monitoring framework (intensive monitoring of a subset of 312 individuals) has been established across the population for detailed condition monitoring. These individuals are located in six loci extending along the range adjacent to the mining operations. The size, life stage and condition of each plant has been recorded and a photographic record for each individual commenced. Monitoring completed in 2003, 2004 and 2005.
9. A three year (minimum) research programme by CALM Science Division and BGPA into the ecology, genetics, population dynamics, *ex situ* storage, and optimum propagation techniques, commenced in 2004, and the first annual reports of progress prepared in March 2005.
10. The Koolyanobbing Project Community Reference Group has been established, with a core element of its charter the review of *Tetratheca paynterae* subsp. *paynterae* ms research and management programmes that are undertaken, and funded, by Portman and include research by CALM Science Division and BGPA.

Interim Recovery Plan Objectives: The objectives of this IRP are to protect remaining *in situ* plants against continuing identified threats, maintain or enhance the conserved *in situ* population (exclusive of approved mining areas) and establish self sustaining translocated populations to ensure the long-term preservation of the species in the wild.

Recovery Criteria:

Criteria for success: The number of *in situ* individuals in areas of current occupancy outside of direct mining operations remain stable (i.e. within 10% of 2003 census result) or increase, and at least one self sustaining translocated population is established.

Criteria for failure: The number of *in situ* individuals in areas of current occupancy outside of direct mining operations has decreased by greater than 10%, or no self sustaining translocated populations were established.

Recovery actions

1. Coordinate recovery actions and provide an annual report.
2. Seek to progress acquisition of Diemals Pastoral Lease.
3. Coordinate the implementation of the research programme.
4. Continue the implementation of the *Tetratheca paynterae* subsp. *paynterae* ms research programme.
5. Implement *Tetratheca paynterae* subsp. *paynterae* ms condition monitoring programme.
6. Map habitat critical to the survival of *Tetratheca paynterae* subsp. *paynterae* ms (potential translocation sites).
7. Continue implementation of translocation trial and develop and implement a full translocation proposal.
8. Meet with, and communicate progress in implementing the IRP to, the Koolyanobbing Project Community Reference Group every 6 months.
9. Maintain adequate seed/germplasm collections to ensure material with a broad genetic base is available for translocation and on-going *ex situ* conservation.
10. Promote awareness of *Tetratheca paynterae* subsp. *paynterae* ms and IRP initiatives.
11. Review the IRP and update as necessary.

1. BACKGROUND

History

The type collection of *Tetratheca paynterae* subsp. *paynterae* ms was made in November 1989 by J.J. Alford from an unnamed series of low ironstone hills (now known as the Windarling Range) north of Southern Cross. The next collection was made by F. & N. Mollemans in 1990 from the same range. Several further collections were made from the Windarling Range between 2000 and 2004.

An initial inventory of the species was conducted in 2000, and identified 2,852 mature individuals in three separate locations on Windarling Range. A subsequent more thorough inventory, conducted by Western Botanical in spring 2003, recorded a total of 7,005 individuals, of which 6951 were mature, from the W3 and W5 orebody areas (Cockerton *et al* 2004). Since the commencement of mining operations in 2004, approximately 1,800 mature plants have been removed in mine development.

In 2001 a population of what is now regarded as a second subspecies was located in the Die Hardy Range some 10 km north-north-east of Windarling. This subspecies will be named *cremnobata* in a future revision of the genus.

The Windarling Range occurs on the Diemals Pastoral Lease, which is used for low intensity beef cattle production. The normal range of stock does not extend to the outcropping ironstone where *Tetratheca paynterae* subsp. *paynterae* ms occurs.

In December 2002 the Environmental Protection Authority recommended against mining at Windarling, partly on the basis of predicted impact on *Tetratheca paynterae* subsp. *paynterae* ms. The State Minister for the Environment granted conditional environmental approval for mining, under the *Environmental Protection Act 1986*, in June 2003 following an appeal by Portman Iron Ore Ltd (Portman). Under the Ministerial Conditions, mining was permitted on an area, drawn on the basis of the 2000 census, that would impact on an initial 30% of the *Tetratheca paynterae* subsp. *paynterae* ms population. Mining on an area supporting a further 20% of the population was made possible with further Ministerial approval, which is subject to the Minister being satisfied that the remaining population is viable. The detailed inventory completed in 2003 confirmed the area of initial mining supported 30% of the population, though the proportion within the area of future potential mining was reduced to 15%. The conditional approval also required the development of a Research and Management Plan, and Recovery Plan for *Tetratheca paynterae* subsp. *paynterae* ms.

Environmental approval that is generally consistent with the terms of the State approval was issued by the Commonwealth Minister for the Environment and Heritage in September 2003, under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).

The State Minister for the Environment issued a permit to take 30% of the *Tetratheca paynterae* subsp. *paynterae* ms population in December 2003, consistent with the terms of environmental approval set under the *Environmental Protection Act 1986*.

Description

A member of the Tremandraceae family, the first species in the genus *Tetratheca* was described by J. E. Smith in 1793, the name referring to the four cells of the anthers. Currently, at least 45 species are recognised, several of which are confined to ironstone hills north of Southern Cross. The rarest of these, *Tetratheca paynterae* (now paynterae subsp. *paynterae* ms), was named by Jenni Alford in honour of Ray Paynter who discovered it in 1988.

The Tremandraceae is an endemic Australian family which comprises three genera, *Platytheca, Tremandra* and *Tetratheca*. While *Platytheca* and *Tremandra* are confined to south-western Australia, *Tetratheca* is more widespread across southern Australia.

Tetratheca paynterae subsp. *paynterae* ms is a single stemmed, long lived, perennial shrub with a robust basal meristem. Mature plants are commonly in the order of 30 to 60 cm wide by 20 to 50 cm deep, but may grow up to 80 cm high. Plants are almost leafless, with stiff dark green, terete, glabrous stems emanating from a single rootstock. Stems are straight to curved, ascending, with widely spaced lateral stems. Opposite pairs of flat, ovate leaves up to 3 mm wide by 8 mm long are present in seedlings and on juvenile stems arising from the meristem. Mature stems are bright green when young and nearly leafless but do exhibit small alternately scattered triangular scale-leaves. One to several pendulous flowers are found at these leaf scale points on mature stems. The attractive flowers have five pink coloured petals. Peduncles are 5 mm to 11 mm long and terete. Calyx lobes are triangular, deciduous, 3.5 mm long by 1.7mm wide.

Flowering is all year around in response to rainfall, but is best between August and December.

Two subspecies of *Tetratheca paynterae* have recently been recognised by Ryonen Butcher who is conducting taxonomic work in the genus. *Tetratheca paynterae* subsp. *paynterae* ms. differs from subsp. *cremnobata* in having leaves that are more pubescent on the upper and lower surfaces, a dense covering of short erect hairs over the ovary and the lower half of the style, brighter yellow tips to the anther tubes and style apex, and wider stem diameters in the flowering region. There is a large overlap in stem widths between the subspecies (Butcher *et al*. 2001; Butcher, personal communication). By contrast, *T. paynterae* subsp. *cremnobata* ms has nearly glabrous leaves, a shiny red ovary with scattered glandular hairs and a small area of short, simple hairs restricted to just below the style, a style which is glabrous or has a few glandular hairs towards the base, and dull mauve-red tipped anther tubes and style apex. The overall growth habit of *T. paynterae* subsp. *cremnobata* ms is more tangled in appearance and the stems are more slender and highly branched, especially in the upper half.

Tetratheca paynterae subsp. *paynterae* ms and subsp. *cremnobata* ms are morphologically similar to *T. aphylla* (Helena & Aurora Ranges), but this latter species differs in having two ovules rather than four, a dense covering of minute, acute tubercles on the stems rather than broader, rounded tubercles, and wider stem diameters (Butcher *et al.* 2001). Both *T. paynterae* and *T. aphylla* are also similar to *T. harperi* (central Jackson Range) and *T. erubescens* ms (Koolyanobbing Range) in their leafless habit and habitat preferences, but these two species are easily distinguished by their glaucous mature stems which are covered in dark bristles (setae). *Tetratheca erubescens* ms can be distinguished from *T. harperi* by its four rather than two ovules, shorter setae on the stems and flowers ranging in colour from white with pink speckles to pale purple.

The seed of each of these *Tetratheca* species and subspecies are distinct, varying in width, length, pubescence and aril shape (Western Botanical 2004). Although a formal analysis has yet to be conducted, general trends appeared to be that *Tetratheca aphylla* has the largest seed, *T. harperi* the narrowest, *T. paynterae* subsp. *paynterae* ms the hairiest and *T. paynterae* subsp. *cremnobata* ms the smallest and least hairy.

Distribution and habitat

Tetratheca paynterae subsp. *paynterae* ms is known to occur only on the Windarling Range near the southern edge of Diemals Station, some 160 km north of Southern Cross, in the Yilgarn region of Western Australia. Parts of the Windarling Range are subject to exploration and mining activities by Portman. *Tetratheca paynterae* subsp. *paynterae* ms occurs on an approximately 1.4 km predominantly north-facing ironstone outcrop on the W3 orebody area. Prior to mining activities commencing in early 2004, it also occurred in two sub-populations on the W5 orebody area, some 250 m south of the W3 ridge. The eastern most sub-population (39 plants) on the W5 orebody has now been taken in mining and the western sub-population (approximately 93 plants) remains.

The Windarling Range is characterized by numerous discrete, narrow parallel ironstone series, two of which are outcropping on the W3 ridge and two on the W5 ridge, interspersed with narrow to broad basalt beds. The range dips to the south at a steep angle (60 degrees) and is variously fractured and weathered with weathering of the basalt being at a faster rate than the outcropping ironstone.

Tetratheca paynterae subsp. *paynterae* ms grows within small to moderately sized lateral cracks in the ironstone. Minimal soil occurs within these rock cracks and what is present is high in organic content, and high in ammonium (NH_4 nitrogen sources) and phosphate (Jasper *et al*, 2002). *Tetratheca paynterae* subsp.

paynterae ms does not extend downslope onto the scree slopes but does occur on non-north facing ironstone outcrops where they occur in the zone of distribution. It is therefore inferred that the occurrence on north facing outcrops is more a function of the bedding and erosion of the ironstone than an intrinsic requirement for north-facing slopes.

Due to the specificity of habitat, few species are associated specifically with *Tetratheca paynterae* subsp. *paynterae* ms. Those present are limited to the annual *Isotoma petraea*, the herbaceous perennial ferns *Cheilanthes sieberi* and *Cheilanthes distans* and very scattered *Calycopeplus pauciflorus*, *Melaleuca leiocarpa*, *Dodonaea viscosa* var. *mucronata* and occasional *Ricinocarpos brevis* (DRF). Rock surfaces have varying amounts of lichen associated with non-north facing surfaces supporting a broader range and greater cover.

The northern face of the Windarling Range is subject to direct solar radiation and contrasts markedly with the southern face where conditions are more moderate. Marked differences in the vegetation of the upper slopes, on soils derived from the weathered basalt with a high proportion of ironstone scree and rubble, are apparent. *Ptilotus obovatus* forms a near monoculture on this hot, exposed north face while it is a co-dominant component of the *Acacia* shrublands on the southern slopes. Trees (*Acacia aneura, A. quadrimarginea, A. tetragonophylla*) and shrubs (*Dodonaea viscosa* var. *mucronata*, *Eremophila clarkei*, *Calycopeplus pauciflorus* and *Ricinocarpos brevis*) reach larger proportions and are more numerous on the upper southern slopes where clay-loam soils derived from weathered basalt may be in the order of 20 to 60 cm deep over massive fractured ironstone.

Summary of population land vesting, purpose and tenure

Population	Vesting	Purpose	Tenure
1. Windarling	unvested	1. Pastoral 2. Mining	1. Pastoral lease (Land Act) 2. Mining Act

Biology and ecology

Plants of *Tetratheca paynterae* subsp. *paynterae* ms sampled from the W3 rock face prior to mining in June 2004 had basal stem diameters ranging from 5 to 10 mm to a massive 60 mm. The latter measure was on a plant with a canopy that was over 1m across and represents a very old individual, although growth rings or other measures of actual age have not yet been investigated.

Limited investigation of roots indicates that there is intricate root development within the supporting rock crevices. Research has identified that endomycorrhizal fungi occurring in association with *T. paynterae* subsp. *paynterae* ms roots may play a critical role in nutrient uptake. However, the massive nature of the ironstone rocks, an apparent high porosity due to rock structure and substantial weathering seems to trap and provide sufficient moisture for plants to maintain flowers some weeks beyond incident rainfall events. The material therein is free draining and does not support waterlogging conditions. Plants are very xerophytic and aestivate over dry, hot months, initiating new shoots in late autumn. These appear dormant over winter then elongate again in spring when temperatures increase. Flower bud development is rapid in warmer weather following rainfall but is reduced in mid winter and during the dry late spring to early summer period.

Flowering follows intermittent seasonal rainfall and has been observed throughout the year, generally with a peak in spring. Potential *Tetratheca paynterae* subsp. *paynterae* ms pollinators have been observed. To date, these have been identified as small solitary native bees in the genus *Lasioglossum*. Two species of *Lassioglossum* (Chilalictus) were observed foraging at *Tetratheca paynterae* subsp. *paynterae* ms flowers (and other *Tetratheca* species in the region) during preliminary pollination studies in 2003. All native bees caught while collecting pollen from flowers were female. It is thought that the pollen is used as a food source for juveniles when they emerge from the egg (McNee, 2005). Incidental pollination may occur during the collection of the pollen.

Tetratheca paynterae subsp. *paynterae* ms flowers contain four ovules and fruits may contain four seeds. At peak flowering in spring, most flowers are pollinated. In samples of 250 flowers collected across the breadth of the population, 92% of flowers in 2003, and 83% of flowers in 2004 had at least one pollen tube at the base of

the style. Although high rates of pollination are observed, this is not reflected in similarly high rates of seed production. In 2004 only 52% of flowers produced a fruit, moreover 70% of fruits did not contain a viable seed (Yates and Dillon, 2005). In 2005 59% of flowers produced a fruit. In late spring as fruits mature and begin to dehisce, seeds are released and may accumulate in rock fissures, but mostly the fate of the seeds following release from fruits is unknown. Seeds have a prominent elaiosome and three species of ants have been observed removing seeds from experimental cafeterias. Ants may have a role in dispersing seeds to safe sites in rock fissures. Seed removal from experimental cafeterias by ants is widespread and swift. At peak seed fall in 2005, 61% of seeds were removed within 24 hours from 40 cafeterias spread across the population (Yates and Dillon unpubl. data).

Seeds germinate and seedlings emerge during the winter wet season, with rates dependent on rainfall (Yates and Dillon unpubl. data). Germination and viability testing of seed collected in 2003 revealed 66% of seed to be viable. Germination rates of 80% were achieved, 40 days after sowing, following pre-treatment of seed with 1000 ppm gibberellic acid (GA_3) and heating at 80^{o}C for 1 hour. Gibberellic acid and heat were generally more effective in promoting germination than smoke water. The germination rate of untreated seed was only 17% indicating physiological dormancy (Butcher *et al.* 2005).

Preliminary genetic assessments of 27 *Tetratheca paynterae* subsp. *paynterae* ms plants from the W3 orebody area by the Botanic Gardens and Parks Authority (BGPA) (Krauss *et al* 2002) suggested that the population was genetically diverse and that outcrossing was likely. Further analyses of over 260 plants sampled in late 2003 revealed moderate levels of genetic diversity with plants on the W5 orebody being genetically distinct from plants on the W3 orebody (Butcher unpubl. data). Genetic differences were also found among groups of plants on the W3 orebody wherever they were separated by distances of 100 m or more (Butcher & Krauss 2005). This suggests pollinators tend to move among adjacent plants rather than moving randomly throughout the population. Plants should be sampled from across the population in order to capture the maximum amount of genetic diversity in translocated populations. Analysis of outcrossing rates from progeny arrays revealed the species is preferentially outcrossing, however there was evidence of inbreeding in plants at the western limit of the species distribution on the W3 orebody (Butcher unpubl. data). These plants are separated from the remainder of the population by about 250 m. Inbreeding can result in lower viability, germination, vigour and survival. This suggests the size of translocated populations and the activity of pollinators is likely to be critical to the sustainability of these populations. Research on the genetics and ecology of *T. paynterae* subsp. *paynterae* ms forms part of a joint current research program by BGPA and the Department of Conservation and Land Management (CALM).

The habitat supporting *Tetratheca paynterae* subsp. *paynterae* ms is unlikely to support a fire due to the lack of organic material present. However, observation of *Tetratheca harperi* on a rock face in the central Jackson Ranges that was adjacent to an area burnt following a presumed lightening strike, showed a high density of small plants of this species compared to similar rock faces more distant from the burnt region. It may be that *Tetratheca* species are fire responsive but do not require direct fire. This hypothesis is supported by BGPA studies that show successful germination of seeds is possible using smoke water.

Tetratheca paynterae subsp. *paynterae* ms can be propagated by cuttings. Marked differences in the success of individual genotypes, based on 10 cuttings per individual, have been exhibited in trials to date. Seedlings can be successfully grown on tissue culture media (Butcher unpubl. data). The propagation of seed in soil media has not yet been successful. Preliminary experiments investigating the influence of the quality and volume of root space on the growth of *T. paynterae* subsp. *paynterae* ms have encountered difficulties with growing seedlings. Of 240 germinants planted across a range of pot volume and nutrient treatments, one plant established (Yates and Dillon unpubl. data). Research into optimum environments for growing plants is ongoing. A translocation trial has been implemented utilizing a few hundred seeds in the western parts of the Windarling Range (Western Botanical 2004, in preparation).

Of the 7005 live plants noted in the spring 2003 census, the majority were mature, over 25 cm in height and over 15 cm in width. Sixty seven juvenile plants, often with some juvenile leaves present at their base and less than 25 cm in height and 15 cm in width were noted. Fifty four current season seedlings to 5 cm high and with opposite juvenile leaves were also noted, indicating a small but significant natural recruitment rate from seeds that are lodged within rock crevices. Summary statistics from the 2003 census are presented below.

Large Mature	Small Mature	Seedling	Total Live	Dead
6,884	**67**	**54**	**7,005**	**256**

Elsewhere in this document, the number of mature plants (6951 individuals) is derived from the addition of large mature (6884) and small mature (67) plants.

Evidence of macropod (Euro) grazing on *Tetratheca paynterae* subsp. *paynterae* ms has been observed throughout the population wherever access is possible. This grazing heavily impacts on some plants with stems chewed to short stumps with minimal green live foliage remaining. Grazed plants do, however, produce a new flush of growth following rainfall. Relatively few dead plants were observed during the inventory conducted in 2003 (256 individuals) and none of these could be attributed to heavy grazing. Mortality is more likely due to insufficient moisture being available for the plant to survive the dry summer. Investigation of scats at these sites and observations of herbivores during spring 2003 indicate that no pastoral animals are responsible for grazing this species. Some grazing by native grasshoppers was noted in June 2004, where parts of the stem cuticle were damaged. No other grazing or impacts on plants has been observed to date.

Threats

Tetratheca paynterae subsp. *paynterae* ms was declared (as *Tetratheca paynterae*) as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* on 17th May 1991 and was ranked as Critically Endangered (CR) in February 2005 under World Conservation Union (IUCN 2000) Red List criterion B1ab(ii,iii,iv) as it is known from just one location (two sub-populations) and there is a continuing decline in the area, extent and quality of habitat due to the reduction in the number of mature individuals and potential impact from nearby mining. The species was listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in July 2000.

The main threat to *Tetratheca paynterae* subsp. *paynterae* ms is direct removal and loss of habitat by mining, with possible secondary threats associated with nearby mining operations and natural environmental factors.

Threats include:

- **Mining (direct removal):** *Tetratheca paynterae* subsp. *paynterae* ms occupies outcropping ironstone formations that are highly prospective for iron ore. Conditional environmental approval has been provided for the removal of an initial 30% of the pre-disturbance population, with potential to remove a further 20% of the pre-disturbance population.

- **Mining (secondary threats):** Nearby mining also presents secondary threats through dust, inadvertent disturbance such as cracking of rock faces, negative effects on pollinator activity arising from habitat disturbance and removal of food plants, and other effects on reproductive biology that may lead to a decline in recruitment rate.

- **Limited Habitat:** *Tetratheca paynterae* subsp. *paynterae* ms is restricted to two outcropping ridges that are moderately geographically separated from other remnant outcropping ironstone formations within the Windarling Range. Distances between areas of suitable outcrop that may support *Tetratheca paynterae* subsp. *paynterae* ms translocations are in the order of several hundred metres to a few kilometres.

- **Weed invasion**: No significant weed invasion has been observed to date. A weed management plan has been developed and implemented by Portman.

- **Grazing:** While evidence of grazing *Tetratheca paynterae* subsp. *paynterae* ms has been observed, this is attributed to a low endemic Euro population (scats found at the site support this). Goats or sheep have not been recorded in the immediate area, most probably due to the lack of surface water.

Summary of population information and threats

Pop. No. & Location	Year/No. plants	Condition	Threats
1. Windarling	2003 6951 (54)* Total of 7005	Healthy	Mining and secondary effects resulting from mining and environmental factors

*Numbers in brackets = number of seedlings.

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

Given that this taxon is listed as Critically Endangered it is considered that all known habitat supporting the existing population and any successfully translocated populations is habitat critical to its survival and that all populations are important populations. Areas of similar rock type are present in the immediate region and, whilst *Tetratheca paynterae* subsp. *paynterae* ms is not represented at these sites, some may prove suitable as potential translocation sites. Recovery actions include survey for further populations that would lead to the identification of additional critical habitat. Habitat is defined as the biophysical medium or media occupied (continuously, periodically or occasionally) by an organism or group of organisms or once occupied (continuously, periodically or occasionally) by an organism, or group of organisms, and into which organisms of that kind have the potential to be reintroduced (*Environment Protection and Biodiversity Conservation Act 1999*). Habitat critical to the survival of *Tetratheca paynterae* subsp. *paynterae* ms includes:

- the area of occupancy of the known population,
- nearby habitat that supports insects necessary for pollination, and
- areas of similar rock type present in the immediate region that are potential translocation sites.

Translocation trials will assist in determining whether additional areas of similar habitat (i.e. outcropping ironstone formations) that do not currently support this, or any other *Tetratheca* species are considered habitat critical to its survival.

Benefits to other species/ecological communities

Recovery actions implemented to preserve the quality and security of the habitat of *Tetratheca paynterae* subsp. *paynterae* ms will also preserve remnant vegetation in which it is located and supports the DRF taxon *Ricinocarpos brevis.*

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. The taxon is not listed under the United Nations Environment Program World Conservation Monitoring Centre (UNEP-WCMC) Convention on International Trade in Endangered Species (CITES). This RP does not affect Australia's obligations under international agreements.

Role and interests of indigenous people

There are two registered Native Title claims over the Windarling area that includes the habitat and potential habitat of *Tetratheca paynterae* subsp. *paynterae* ms. In agreements with Portman, the claimant groups have recorded a general interest in the environment of the area. There are no registered ethnographic or archaeological sites within the habitat of *Tetratheca paynterae* subsp. *paynterae* ms.

Social and economic impacts

The implementation of this Interim Recovery Plan will have some economic impact through the funding the development and implementation of this plan and because sections of the population that are protected in accordance with statutory environmental approvals have restricted access to underlying iron ore deposits.

There may also be some social impact associated with the potential acquisition of the Diemals Pastoral Lease by Portman to provide for more secure land tenure over the *Tetratheca paynterae* subsp. *paynterae* ms population. There is also potential for translocation sites to also complicate future access to mineral resources.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Any further development in the vicinity of existing or potential habitat requires assessment. No development should be approved unless the proponents can demonstrate that it will not have a long-term deleterious impact on the species, its habitat or potential natural habitat.

Evaluation of the Plan's performance

CALM and the Department of the Environment and Heritage (DEH, Commonwealth), in conjunction with the Goldfields Region Threatened Flora Recovery Team (GRTFRT) and the Koolyanobbing Project Community Reference Group will evaluate the performance of this RP. In addition to annual reporting on progress and evaluation against the criteria for success and failure, the plan will be reviewed following ten years of implementation.

2. RECOVERY OBJECTIVE AND CRITERIA

Interim Recovery Plan Objective:

The objectives of this Interim Recovery Plan are to protect remaining *in situ* plants against continuing identified threats, maintain or enhance the conserved *in situ* population (exclusive of approved mining areas) and establish self sustaining translocated populations to ensure the long-term preservation of the species in the wild.

Recovery Criteria:

Criteria for success: The number of *in situ* individuals in areas of current occupancy outside of direct mining operations remain stable (i.e within 10% of 2003 census result) or increase and at least one self sustaining translocated population is established.

Criteria for failure: The number of *in situ* individuals in areas of current occupancy outside of direct mining operations has decreased by greater than 10%, or no self sustaining translocated populations were established.

3. RECOVERY ACTIONS

Existing recovery actions

Mining exclusion zones have been imposed in accordance with Ministerial environmental approvals (State - Statement 627, 3 June 2003; Commonwealth – 4 September 2003).

Portman have entered into an agreement for the acquisition of Diemals Pastoral Lease a portion of which is to be made available to the State to provide for secure conservation tenure over *Tetratheca paynterae* subsp. *paynterae* ms habitat.

Approximately 35,000 seeds were collected in the period September to December 2003 from the section of the population to be impacted by mining. These have been evenly distributed (August 2004) between the BGPA, CALM and Western Botanical, the latter implementing translocation and propagation trials on behalf of Portman. A further 7100 seeds (estimated) were collected from the area approved for mining in late 2004.

Approximately 2500 cuttings that were collected from approximately 250 plants across the population in the period September to December 2003 have been propagated by BGPA and potted on by Western Flora, with mixed results.

A comprehensive, reproducible population census was completed in the period September to December 2003.

Studies into genetic structure, abundance, viability and germination of soil stored seed bank and habit description were completed by BGPA (Krauss *et al* 2002) and CALM Science Division (Butcher *et al* 2001 & 2002) in 2002.

A *Tetratheca paynterae* subsp. *paynterae* ms impact management plan has been developed and approved by DEH in accordance with environmental approvals. This plan provides measures to limit the risk of secondary mining impacts on the species (i.e. such as inadvertent disturbance, excessive dust deposition, fire impact and weed invasion), and also provides for monitoring to track plant condition. An annual report on implementation was produced in March 2005.

A representative monitoring framework (intensive monitoring of a subset of 312 individuals) was established across the population for detailed condition monitoring. These individuals are located in six loci extending along the range from adjacent to the mining operations. The size, life stage and condition of each plant is recorded and a photographic record for each individual commenced. Monitoring has been completed in 2003, 2004 and 2005.

The non-mining areas of *Tetratheca paynterae* subsp. *paynterae* ms habitat have been designated as local conservation areas. Signs have been installed demarcating the conservation areas and access has been restricted.

A three year (minimum) research programme into the ecology, genetics, *ex situ* conservation, seed biology, population dynamics and optimum propagation techniques by staff from CALM's Science Division and the BGPA commenced in 2004, and the first annual reports of progress prepared in March 2005. The programme is attached at Appendix A.

The Koolyanobbing Project Community Reference Group has been established, with a core element of its charter the review of *Tetratheca paynterae* subsp. *paynterae* ms research and management programmes undertaken by Portman.

Future recovery actions

Many of the actions described below were initiated in 2004, and are ongoing. This section details the planned implementation of these recovery actions, and others, from the commencement of the Interim Recovery Plan in 2006.

1. Coordinate recovery actions and provide an annual report

Portman will ensure the implementation of research, management and recovery actions for *Tetratheca paynterae* subsp. *paynterae* ms in consultation with CALM, DEH and the GRTFRT. An annual progress report will be produced by 31 March each year.

Action: Coordinate recovery actions and provide an annual report
Responsibility: Portman Iron Ore Ltd and CALM through the GRTFRT
Timing: ongoing
Cost: $5000 per annum

2. Seek to progress acquisition of Diemals Pastoral Lease

Portman will seek to progress its agreement for the acquisition of Diemals Pastoral Lease with the objective of making an area available to the State for addition to the conservation estate.

Action: Seek to progress acquisition of Diemals Pastoral Lease.
Responsibility: Portman Iron Ore Ltd
Timing: ongoing
Cost: $5000 (process cost, not the price of the lease)

3. Coordinate the implementation of the research programme

Portman has engaged CALM (Research Division) and BGPA to undertake applied research into the biology and ecology of *Tetratheca paynterae* subsp. *paynterae* ms, as detailed in Appendix A. Western Botanical also undertake research related work. These activities will be coordinated to ensure efficiency in the fieldwork and research effort. Overall the research programme is budgeted to cost approximately $750 000 in the period January 2004 to December 2006.

Action: Coordinate the implementation of the research programme through periodic meeting and reporting
Responsibility: Portman Iron Ore Ltd
Timing: Approximate 6 monthly intervals, 2004 – 2006.
Cost: $10 000 per annum

4. Continue implementation of the *Tetratheca paynterae* subsp. *paynterae* ms research programme

A comprehensive programme of research into the ecology, population dynamics, population genetics and propagation techniques is currently being implemented and is ongoing. The key research fields are described below. The initial research programme will extend to December 2006, at which time the direction of future research will be reviewed. The nature of some of the research is longer term (5 years minimum).

Cost $750 000 over three years ($480 000 incurred in 2004 & 2005; $270 000 in 2006)

Research includes conservation genetics, population ecology and viability, propagation studies, *ex situ* storage of germplasm and restoration and translocation. These actions are outlined below:

Conservation Genetics

Actions: Undertake genetic analysis of *Tetratheca paynterae* subsp. *paynterae* ms and *T. paynterae* subsp. *cremnobata* ms.
Characterise the genetic variation and differentiation within the *T. paynterae* subsp. *paynterae* ms population.
Characterise the mating system, and pollen and seed movement.
Assess the risk of genetic erosion through inbreeding.
Responsibility: Portman Iron Ore Ltd and BGPA
Timing: 2004 – 2006 (initially)

Population Ecology and Viability

Actions: Quantify population vital rates, such as fecundity (flowering and seed seed production), seed bank dynamics, generation (seedling recruitment), plant mortality, plant growth and dormancy, of *Tetratheca paynterae* subsp. *paynterae* ms, T. *paynterae* subsp. *cremnobata* ms, *T. aphylla* and *T. harperi* .
Study the ecological interactions that affect population vital rates including pollination, seed predation, seed dispersal, herbivory, fire and rainfall.
Undertake integrated population viability analyses that predict potential for stability or growth (subject to data collection extending beyond initial commitment to Dec 2006).
Responsibility: Portman Iron Ore Ltd and CALM Science Division
Timing: 2004 – 2006 (initially)

Propagation Studies

Action: Investigate the optimal techniques for the propagation of *Tetratheca paynterae* subsp. *paynterae* ms by seed, cuttings and tissue culture.
Responsibility: Portman Iron Ore Ltd and BGPA
Timing: 2004 – 2006 (initially)

Ex situ Storage of Germplasm

Action: Determine optimal conditions for long term seed and germplasm storage, and distribute material for secure storage in appropriate repositories.
Responsibility: Portman Iron Ore Ltd and BGPA
Timing: 2004 – 2006 (initially)

Restoration and Translocation

Action: Describe biotic and abiotic environments and habitat requirements. Trial *in situ* planting methods.
Identify critical parameters for the long-term viability of translocated and re-established populations of *Tetratheca paynterae* subsp. *paynterae* ms and related species
Identify an optimal arrangement of genotypes for translocated populations of *Tetratheca paynterae* subsp. *paynterae* ms.
Derive quantitative completion criteria which demonstrate maintenance of viable population dynamics and resilience in *T. paynterae* subsp. *paynterae* ms.
Responsibility: Portman Iron Ore Ltd, CALM (Science Division) and BGPA
Timing: 2004 – 2006 (initially)

5. Implement *Tetratheca paynterae* subsp. *paynterae* ms condition monitoring programme

The condition of the *Tetratheca paynterae* subsp. *paynterae* ms population not directly impacted by mining will be monitored annually for any indirect impacts, of which the greatest risk may be excessive dust deposition. A representative subset of 312 individual plants will be monitored in detail and the remainder of the population will be monitored through observation. Informal visual monitoring will be undertaken on an ongoing basis. This information will be included in the annual report to the Recovery Team (Future Action Item 1).

Action: Undertake condition monitoring
Responsibility: Portman Iron Ore Ltd, Western Botanical
Timing: Annually (Oct – Nov), 2004 - 2015
Cost: $15 000 per annum

6. Map habitat critical to the survival of *Tetratheca paynterae* subsp. *paynterae* ms (potential translocation sites)

The extent of the existing population of *Tetratheca paynterae* subsp. *paynterae* ms has been mapped in detail. Fieldwork will be undertaken to identify potential sites for translocation both in the immediate proximity of the existing population and further afield.

Action: Map habitat critical to the survival of *Tetratheca paynterae* subsp. *paynterae* ms
Responsibility: Portman Iron Ore Ltd, Western Botanical in consultation with CALM
Timing: 2005 – 2006
Cost: $20 000 between 2006 – 2007

7. Continue implementation of translocation trial and develop and implement a full translocation proposal

Commonwealth Ministerial environmental approvals for mining by Portman require research into the potential translocation of *Tetratheca paynterae* subsp. *paynterae* ms. Much of this research is included in the research programme addressed under (3) above. A translocation trial would provide substantial information on the translocation potential of the species. Given the variability in climate conditions (and therefore growing and propagation conditions) from one year to the next it is of greatest benefit to have commenced a trial as soon as practicable and within the time frame of a Recovery Plan. An initial trial proposal was approved on behalf of the Director of Nature Conservation, CALM on 6 July 2004 and commenced the same month. The trial essentially comprises the planting of smoke treated seeds on potential habitat and is constrained to the immediate vicinity of Windarling Range. A full translocation trial will be developed as results are obtained and data on prospective sites (Action 6) is gathered. Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No. 29 *Translocation of Threatened Flora and Fauna*.

The definition of 'successful translocation' in Policy Statement No. 29 is: 'one that provides a self-perpetuating population with at least 90% of the genetic diversity of the source population, without expensive, non-routine management'. Guidance on the establishment of introduced population is provided in "Guidelines for the translocation of Threatened Plants in Australia" (Vallee *et al* 2004). Criteria for successful establishment of an introduced population will be provided in the Translocation Proposal developed to implement this action.

Action: Continue implementation of translocation trial
Responsibility: Portman Iron Ore Ltd through the GRTFRT
Timing: 2006 (tentative)
Cost: $15000 per annum

8. Meet with and communicate progress in implementing the Interim Recovery Plan to the Koolyanobbing Project Community Reference Group every 6 months

The progress of *Tetratheca paynterae* subsp. *paynterae* ms research, management and recovery activities will continue to be reported to the Koolyanobbing Community Reference Group. Developments will be reported as they arise at the next meeting of the group (which occur every 6 months) or in written updates which are provided every two months between meetings. The formal progress reports required by 31 March each year (refer to action 1) will also be provided to the group.

Action: Communicate progress to Community Reference Group
Responsibility: Portman Iron Ore Ltd
Timing: ongoing
Cost: $5000 per annum

9. Maintain adequate seed/germplasm collections to ensure material with a broad genetic base is available for translocation and on-going ex situ conservation

Maintain adequate seed/germplasm collections to ensure material with a broad genetic base is available for translocation and on-going *ex situ* conservation

Action: Maintain adequate seed/germplasm collections
Responsibility: Portman Iron Ore Ltd through the GRTFRT
Timing: ongoing
Cost: $300 per annum

10. Promote awareness of *Tetratheca paynterae* subsp. *paynterae* ms and Interim Recovery Plan initiatives

The status of *Tetratheca paynterae* subsp. *paynterae* ms and the measures to preserve the species will be promoted. The significance of the species will continue to be communicated to personnel working at and around the Windarling minesite, through an environmental induction and an Environmental Handbook.

Actions: 1. Prepare promotional leaflet
2. Continue environmental inductions and Environmental Handbook dissemination
Responsibility: 1. Portman Iron Ore Ltd through the GRTFRT
2. Portman Iron Ore Ltd
Timing: 1. by December 2006
2. ongoing
Cost: 1. $7 000
2. $5000 per annum

11. Review the Interim Recovery Plan and update as necessary

The relevance and effectiveness of the plan will be reviewed after 10 years and the plan updated as necessary.

Action: Review the Interim Recovery Plan and update as necessary
Responsibility: Portman Iron Ore Ltd through the GRTFRT
Timing: February 2016
Cost: $10000

4. TERM OF PLAN

This Interim Recovery Plan will operate from February 2006 to January 2016 but will remain in force until withdrawn or replaced. The plan will be reviewed in 2016 based on the ranking of the taxon at that time.

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6. TAXONOMIC DESCRIPTION

Alford, J.J. Nuytsia Volume 10, No. 2. (1995) pp 146 – 149, Figure 2.

Typus: Unnamed hills, approximately 120km north of Bullfinch (precise locality withheld), Western Australia, 8 November 1989, J.J. Alford 1360 (*holo*: PERTH 03284093; *iso*: CANB, NSW).

Small *shrub*, 0.15-0.4m high, erect to decumbent with woody stock. *Stems* divaricate; branches alternate, often terminating in a brown or silver slender point, terete, 0.7-2.3 mm diameter; irregularly longitudinally striate, glabrous but with dense minute tubercles; new growth densely hispid. *Leaves* sparse, early deciduous and often apparently absent, scattered along the stems, sessile, narrowly triangular, 1.7 mm long, 0.6 mm wide, both surfaces hispidulous; seedling and resprouting leaves elliptic to ovate, 5.1-8 mm long, 2.3-2.8 mm wide. *Flowers* with distinctive dank musky odour, occurring singly (occasionally paired) in axils of leaf-bases. *Bracts* clustered, fleshy, keeled, acuminate, 0.5-1.5 mm long, reddish, tuberculate, scabrous outside, pubescent inside. *Peduncles* often slightly recurved, 5.1-11.0 mm long, 0.3-0.5mm in diameter gradually thickened towards apex, longitudinally striate, glossy green and red, sparsely tuberculate, scabrous with the hairs minute and occasionally resin-tipped; receptacle 1.0-1.5 mm diameter. *Calyx* segments 5(6), deciduous, 3.33-5.5 mm long, 1.1-1.7 mm wide, narrowly triangular, acute, green but red near base and on margins in fresh material, with short stiff hairs and strigose hairs on both surfaces, pubescent close to the margin on upper surface, the strigose hairs occasionally resin-tipped on lower surface. *Petals* 5(6), obovate to elliptic, acuminate, deciduous, 6.9-12.8 mm long and 4.1-7.8 mm wide (the widest point being *c*.1/3 from the apex), deep pink with yellow spot at base. *Stamens* 10(12), 3.7-5.1 mm long, pairs of stamens share a common filament, strongly infolded together in bud; filament 0.4-0.7 mm long; body of anther 2.5-3.4 mm long; anther tube 0.7-1.2 mm long, slightly curved, sparsely hispidulous. *Ovary* tapered upwards to the stigma, green with red on margins of carpels, densely hispidulous and sparsely glandular pilose; ovules 4, 2 per loculus. *Fruits* compressed obovoid, 5.6-8.4 mm long, 4-6 mm wide, sparsely to densely hispid, with occasional resin-tipped hairs; rim of receptacle prominent and persistent, 2-3 mm long. Seeds c. 3.6 mm long, 1.3 mm wide, pale to medium brown, silky with long simple hairs; elaiosome prominent, 0.9-1.8 mm long, cream-coloured; embryo narrowly elliptic, pale green.

Appendix A

Tetratheca paynterae subsp. *paynterae* ms Research Programme