

# Prediction of the habitat for *Tetratheca juncea* in the Munmorah area, near Wyong, New South Wales

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## Abstract

Payne, R.J. (c/- Andrews Neil, 207 Albany Street North, Gosford, NSW Australia, 2250) 1993. Prediction of the habitat for *Tetratheca juncea* in the Munmorah area, near Wyong, New South Wales. *Cunninghamia* 3(1): 147-154. *Tetratheca juncea* (Tremandraceae) is a rare plant of the coastal area between Wyong and Bulahdelah. A large population of the species at Munmorah is being reduced because its habitat is being destroyed by infrastructural development. Site conditions have been identified that may be used to locate other populations occurring further north and west of the current survey.

## Introduction

*Tetratheca juncea* Sm. (Tremandraceae) is a species difficult to locate amongst natural vegetation. Its morphological features are such that it is not easily distinguished amongst other shrubs, herbs, grasses and graminoids in most seasons, but is conspicuous when in flower. Although collections have been recorded from the Sydney suburban area, it is now believed to be extinct there (Harden, 1992). Other occurrences are from the Wyong-Bulahdelah area north of Sydney (collections held in the National Herbarium of New South Wales and records of the New South Wales National Parks and Wildlife Service). It is included on the rare or threatened Australian plants list of Briggs and Leigh (1988) with a coding of 3VCi indicating that it is a vulnerable species and is inadequately conserved.

Previous collections provide scant information on the habitat of *Tetratheca juncea*. Residential development around Sydney has eliminated its habitat but a large population has recently been found in the Munmorah area, near Wyong, north of Sydney. The population at Munmorah lies alongside the Pacific Highway and occurs west as far as Point Wolstoncroft on the Triassic Clifton Sub-group geological formation (Uren, 1977). This paper provides details of the habitat of *Tetratheca juncea* and the future conservation needs of the population.

## Locations

*Tetratheca juncea* has been recorded from localities between Sydney and Bulahdelah (Fig. 1). Collections from the Sydney area (e.g., Carlton, Kogarah, Bexley and Undercliff) are early records and the species is now believed to be extinct in those areas (Harden, 1992). Although no habitat details are given, localities suggest the species grew in areas of Hawkesbury Sandstone.

Collections from the Wyong to Bulahdelah area (Fig. 1) are poorly documented in herbarium records. They indicate that the species grows in poor sandy soils around Lake Macquarie but at Bulahdelah grows on a wider range of soils from clays to limestones. At Redhead it has been reported from aeolian sands.

Few of the past records give details of associated vegetation. At Swansea it has been reported in *Angophora costata*-*Eucalyptus haemastoma* forest whilst at Bulahdelah from woodland of *A. costata*-*Allocasuarina littoralis*. On the aeolian sand dunes at Redhead it occurs in *Banksia aemula* heathland.

In the Lake Macquarie area Bartrim and Martin (1986), Kidd (1991) and Winning (1992) have more recently documented specific sites for *Tetratheca juncea* and have given details of vegetation associated with the species. Both Bartrim and Martin (1986) and Winning (1992) describe it as occurring in woodland/forest of *Eucalyptus haemastoma*, *Eucalyptus gummifera* and *Angophora costata* although on one occasion it was recorded in forest of *E. maculata*-*E. paniculata* at Green Point. All of the sites reported occur in relative close proximity to Lake Macquarie with some outlying populations near Mt Sugarloaf to the north west.

### Populations in the Munmorah area

Populations of *Tetratheca juncea* were recorded during field investigations in June 1991 in the Munmorah area. A corridor, approximately 5 kilometres long, through natural vegetation on hilltops and valleys between Munmorah and the Wallarah Colliery was examined. Surrounding lands covering a total area of 12 square kilometres including the Munmorah State Recreation Area and sites at Point Wolstoncroft were also examined, specifically on hilltops but not valleys. At least 14 sites revealed populations of *Tetratheca juncea*, although only eight sites are detailed here (Table 1). Both populations and isolated plants were recorded. A population was designated where more than 20 plant clumps could be recorded along a ridge length of 100 metres. A small population was considered to contain between 20 and 50 plant clumps but a large population was considered to contain more than 50 plant clumps.

At Munmorah *Tetratheca juncea* occurs only in low forest/woodland of the *Angophora costata* complex. Benson (1986) includes *Eucalyptus gummifera*, *E. capitellata* and *Allocasuarina littoralis* as the dominants in the association and classifies the community as 9(g) for the Gosford-Lake Macquarie map sheet. This aptly describes the association at Munmorah except that *Eucalyptus haemastoma* occasionally dominates also. The structure is generally a low open-forest with a low cover of herbs, shrubs, monocotyledons and grasses. Associated species in the understorey are variable but dominants include *Macrozamia communis*, *Acacia myrtifolia*, *Lomandra obliqua*, *Dodonaea triquetra*, *Pimelea linifolia*, *Pultenaea villosa* and *Lambertia formosa*. *Themeda australis* (Kangaroo grass) is always present as the dominating grass, either as a dense or sparse cover. Other grasses such as *Entolasia stricta* can sometimes be present but only as occasional plants.

Populations of *Tetratheca juncea* at Munmorah appear to be confined to narrow, long, smooth hilltops, although the habitat of one collection at Charmhaven nearby, (collection in National Herbarium of New South Wales) is described as 'clay soil alongside creek'. Where it is found on hilltops the population does not extend very far over side slopes and it could not be found alongside drainage lines in the gullies. The Munmorah population appears to be restricted to this topographical feature and appears to be made up of scattered individuals and small populations commonly occurring over a wide area.

Winning (1992) reports that *Tetratheca juncea* occurs in generally the same vegetation type for the larger populations in the Lake Macquarie area but a range of habitats were recorded. Small populations of plants were found to be present in heath vegetation on sands, in shrublands on sandflats, in gullies and in Spotted Gum-Ironbark forest. Kidd (1991) also reports the same vegetation type but in one location, Catherine

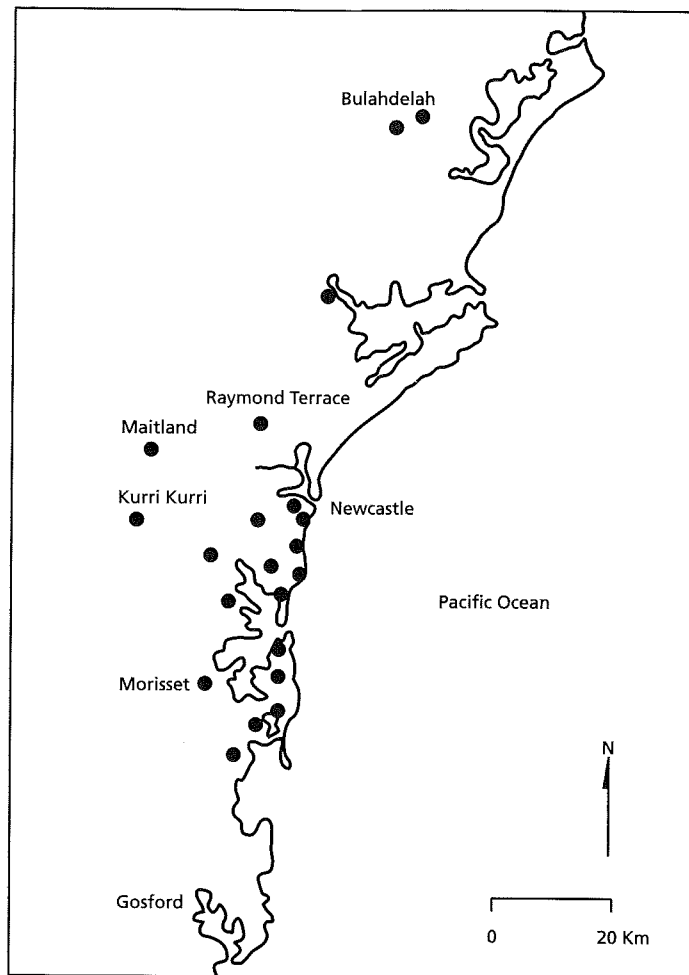


Figure 1. Reported locations of *Tetratheca juncea* from Lake Macquarie–Newcastle–Bulahdelah district.

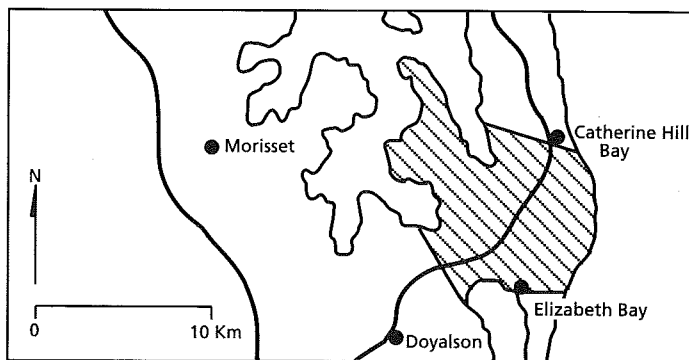


Figure 2. Area at Munmorah showing where *Tetratheca juncea* occurs (shaded).

Table 1 Site attributes for *Tetratheca juncea* at Munmorah. Site numbers refer to grid references on the Catherine Hill Bay 1:25 000 map sheet

Site	Topography	Soil	Vegetation	Distance from the sea	Abundance	Remarks
690275	Plateau	Shallow skeletal sand	<i>Angophora costata</i> complex (Forest)	3km	Isolated plants	Dense cover of <i>Themeda australis</i> and other shrubs
700275	Plateau	Shallow skeletal sand	<i>Angophora costata</i> complex (Low Woodland)	2km	Large population	Sparse ground cover due to wildfire 1990
705281	Plateau	Shallow skeletal sand	<i>Angophora costata</i> complex (Forest)	1.5km	Large population	Dense cover of <i>Themeda australis</i> and other shrubs
703268	Plateau	Shallow skeletal sand	<i>Angophora costata</i> complex (Low stunted Forest)	1km	Large population	Dense cover of <i>Themeda australis</i> and other shrubs
701287	Plateau	Shallow skeletal sand	<i>Angophora costata</i> complex (Forest with some clearing)	2km	Small population	Sparse cover of <i>Themeda australis</i> and other shrubs - disturbed ground
703293	Plateau	Shallow skeletal sand	<i>Angophora costata</i> complex (Forest)	2km	Isolated plants	Dense cover of <i>Themeda australis</i> and other shrubs
702292	Plateau	Shallow skeletal sand	<i>Angophora costata</i> complex (Trees cleared)	2km	Large population	Disturbed ground. Some cover of <i>Themeda australis</i> and other shrubs
709299	Plateau	Shallow skeletal sand	<i>Angophora costata</i> complex (Forest)	2km	Isolated plants	Dense cover of <i>Themeda australis</i> and other shrubs

Hill Bay, the species was present in *Eucalyptus botryoides*, *Angophora* spp.–*Allocasuarina torulosa* forest.

The geology at Munmorah is the Clifton-subgroup of the Narrabeen Group (Uren, 1977). Exposed surfaces through roadside cuttings indicate a shallow sandy soil profile underlain by yellow sedimentary sandstone strata with conglomeritic and gravelly intrusions. Soil derived from this strata is a coarse yellow skeletal sand with little clay material present. Further north in the Lake Macquarie area the main populations tend to occur in clayey soils derived from conglomerates of the same geological formation. Specifically the populations were found to be present on ridges or upper slopes and generally favoured a southerly or easterly aspect (Winning, 1992).

Other soils on hilltops in the Munmorah locality are deeper grey podsolised sands which are also occupied by the *Angophora costata* complex but with a forest structure instead. Moist organic sandy soils and dry podsolised sands are also present where sedgeland of *Ptilanthelium duestum*, *Leptocarpus tenax* and *Lepyrodia scariosa* and heathlands of *Banksia oblongifolia*, *Hakea bakerana* and *Philothea salsolifolia* occur. *Tetratheca juncea* does not appear to occur in the latter two habitats. On a broader scale the vegetation between the various populations where the species is now known to occur has not yet been investigated in different localities.

*Tetratheca juncea* is described as a coastal species (Harden, 1992) but appears to require some degree of shelter. The population at Munmorah does not occur adjacent to the sea and always lies behind the wind-sheared vegetation zone, although at Redhead it occurs in low heath directly exposed to onshore winds (Winning, pers.comm.). Elsewhere the species occurs inland as far as Maitland and Kurri Kurri (Fig. 1). Rainfall ranges from 1160 mm annually at Wyong to 926 mm at Newcastle (Bridgeman, 1984). For the Sydney sites it is about 1100 mm annually (Bureau of Meteorology 1975).

### Population size — Munmorah State Recreation Area

Within the Munmorah State Recreation Area plant populations were examined in detail during September 1992. Three main populations are present which are all in close proximity to one another (Table 2). It is an easy task to count the number of groups of plants along the narrow plateaux but it is difficult to decide whether plants are comprised of a number of separate individuals or are simply multi-stemmed plants. Some plants can occupy an area of 0.5 m<sup>2</sup> comprising 50–60 individual stems. In this survey, therefore, counts of plants are referred to as 'plant clumps'.

**Table 2.** Plant Clumps present in the Munmorah State Recreation Area. Site Numbers refer to grid co-ordinates on the Catherine Hill Bay 1:25 000 map sheet

Site	No. of plant clumps	Aspect
700275	103	North-east
	51	South-west
705281	27	North-east
	31	South-west
703268	44	East
	61	West
713273	6	South

## Results

Populations of *Tetratheca juncea* could be located if conditions of topography, soil, vegetation and distance from the sea were suitable (Table 1). If one condition was unsuitable it was found that the species was not present. The Munmorah population could be related to remnant land surfaces with topography being the main determinant. Further north in the Lake Macquarie area the same habitat conditions may not necessarily apply.

The populations of *Tetratheca juncea* in the Sydney area could be expected to have occurred on similar soils, in the sense that they were infertile, shallow, stony and skeletal. Benson and Howell (1990) describe the Hawkesbury Sandstone soils in Sydney as being invariably sandy and containing rock fragments in areas of rugged slopes and plateaux. Records for locations in the Lake Macquarie and Newcastle areas (Table 3) show that it probably also occurred in drier habitats.

There are two secondary factors that appear to influence the size of the populations of *Tetratheca juncea*. These affect the abundance of plants in the population rather than the presence or absence of the population. Abundant occurrences of plants appears to be related to both the degree of canopy cover and associated understorey cover. Isolated plants occurred under a denser canopy but in low very open-woodland the abundance of plants appears to be greater. Furthermore the abundance of plants is greater in areas of sparse understorey cover in some cases. It is thought that as the cover of *Tetratheca australis* (Kangaroo Grass) increases, competition restricted the availability of sites for *Tetratheca juncea* to survive. In one area of the Munmorah State Recreation Area, the number of plants was relatively abundant where fire had burnt the understorey grass cover the previous year. The populations further north were also found to occur with open grassy understorey (Winning, 1992).

*Tetratheca juncea* survives fire but it is not known whether it resprouts or re-seeds. However it did flower and set seed the year following fire at Munmorah in 1991 and again in 1992. Field observations revealed that it flowered between the beginning of August through to January and sets seed beginning in October but no information is available on the effects of the species from frequent fire. Winning (1992) points out that the populations that were near Seahampton in 1986 were burnt in a May 1991

**Table 3.** Habitat of *T. juncea* in the Lake Macquarie–Newcastle district shown from collections in the National Herbarium of New South Wales and reported by Gutteridge Haskins and Davey Pty Ltd (1986). Rainfall Data from Bridgeman (1984)

Site	Soils	Vegetation	Topography	Annual average rainfall (mm)
Swansea	No data	<i>Angophora costata</i> complex	No data	1100
North of Lake Munmorah	Sandy soil	Open dry sclerophyll forest	No data	1160
Belmont	Sandy soil	No data	No data	1100
Raymond Terrace	Shale	Dry sclerophyll forest	No data	1031
Redhead	Aeolian sands	<i>Banksia aemula</i> heathland	Sand dunes	926
Killingworth	No data	open forest and woodland	South facing ridges and slopes	1050

fire, but could not be located in September 1991. At Jewells Swamp frequent fires (five fires in nine years) caused the plants to virtually disappear. It may be that the species requires twelve months for germination to occur following fire and to perpetuate the species it may have to be managed in relation to the degree of understorey vegetation cover although more research is needed for confirmation.

## Discussion

How can long-term management be achieved, when the conservation of the species may be inadequate? The population in the Munmorah Recreation Area is less than 5.6 hectares whilst the remainder of the known population unprotected covers at least an area of 16 hectares on the narrow ridges (Figure 2). This excludes associated catchment areas. Winning (1992) recorded 1416 individuals and plant clumps for site 700275 in September 1991 compared with an estimate of 154 clumps from this survey but much of the former population may be present in road reserves. The National Parks and Wildlife Service is only able to manage the population on lands held within its authority. Remaining lands where the population occurs are privately owned and the future of *Tetratheca juncea* on those lands cannot be assured. However it is noted that there are 50 plants in the Awabakal Nature Reserve and a further 1434 plants in Glenrock State Recreation area (Winning, 1992).

The locations where the populations of *Tetratheca juncea* occur will be subject to land development and infrastructural pressures even within the Munmorah Recreation Area. Hilltops have available areas of flatlands and have been used for roads, quarries, spoil heaps, residential development and services. It appears some previous surveys have failed to identify the species and the population here has now disappeared under grassed embankments associated with this development. This development scenario combined with more frequent fire patterns is reducing the population significantly. It can only be anticipated, based on current trends, that the conservation of the Munmorah population is in doubt unless steps are taken to extend the reserved area. A population of 1000 plants for *Tetratheca juncea* may not necessarily be considered adequate to conserve the species. The plants are so thinly populated in the field over small areas with large areas between populations that they could be considered at risk until such times that a large catchment area is included with any reserve proposal.

A specific search has so far has only proceeded as far north as the Wallarah Colliery and west to Point Wolstoncroft but there are records of *Tetratheca juncea* further north and west on similar topographic features and within a similar rainfall band (Figure 1). Detailed surveys need to be undertaken to ascertain the total population and its future conservation potential. It is anticipated that hilltops in the locality with natural vegetation of the *Angophora costata* complex would contain populations of *Tetratheca juncea*. BHP Australia recently commissioned a survey on the distribution of *Tetratheca juncea* and have now found a number of new populations west of Lake Macquarie. In addition research is proceeding into cultivation using seed germination and cutting trials.

## Conclusions

The occurrence of populations of *Tetratheca juncea* at Munmorah can be predicted on site conditions of topography, soil, vegetation and distance from the sea. This information will be useful for future surveys. However the future of the population at Munmorah is at risk unless planning strategies change. The vulnerable coding should remain until these planning strategies change and additional reserve area is sought to reserve the population elsewhere in a larger catchment scheme. Conserving isolated populations on a subcatchment basis may not be amenable to the survival of a population. And the lack of scientific data on the species should not be used as a basis for approving development when populations occur.

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