

SHORT COMMUNICATION

Ecology and conservation status of *Muehlenbeckia tuggeranong* (Polygonaceae) near Canberra

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Introduction

Muehlenbeckia tuggeranong Mallinson (Family Polygonaceae) discovered in 1997, is known from one population of seven plants near Canberra, and should be provisionally regarded as highly endangered. Habitat is described, threat processes identified, and recommendations are made for conservation priority codings and management actions.

Biology

Plant form: *Muehlenbeckia tuggeranong* is a procumbent or sprawling, scarcely woody subshrub, eventually becoming a loose tangled mound of wiry stems, up to 1 m high and 1–2 m across. Leaves are alternate, with laminae oblong to elliptical or almost violin-shaped, 5–13 mm long by 2–4 mm wide. Flowers are inconspicuous, 4–5 mm diam., usually in lax terminal spikes 5–20 mm long. Fruits are trigonous nuts c. 3 mm long. A full description and discussion of affinities are given in Makinson & Mallinson (1997).

Reproduction: Flowering has been observed from December to late February. Pollination vectors are unknown and it is not yet clear whether any effective pollination is occurring at the site. No fully mature fruits have been found over two (dry) summers, and no seedlings have been observed. The breeding system of the plant is unknown, although post-disturbance (often post-fire) explosive recruitment in some other species of *Muehlenbeckia* (Hunter et al., 1998; R. Makinson pers. comm.) does suggest that features of the genus include a tolerance to cyclic in-breeding and/or a long dormancy of propagules in the soil seed-bank. Dioecy is the general rule in the genus, although occasional monoecy has been observed (Wilson, 1990: 284). One male plant of *Muehlenbeckia tuggeranong* is doubtfully hermaphrodite, having fertile anthers and (in 1997) some swollen ovaries, but functional hermaphroditism is not confirmed. Growth rates are unknown, but likely to be slow. Cultivated material has shown an ability to root-sucker, but neither root-suckering nor rhizotomy have yet been confirmed in the field. The known population comprises six males and one female.

Disease: Leaf-galls are present on some plants, causing reddish swellings and distortion of the leaf blade. The galls are up to several millimetres in diameter. The causative agent has been identified as a mite of the family Eriophyidae (M. Colloff, pers. comm.). Further work by one of us (Stadler) suggests that this is an undescribed species. The microscopic mites are found in clusters inside the galls. Similar galls occur in most populations of *Muehlenbeckia axillaris* (R. Makinson, pers. comm.). The galls persist on *Muehlenbeckia tuggeranong* in cultivation.

Habitat

Distribution: *Muehlenbeckia tuggeranong* occurs immediately south west of Canberra, in the Australian Capital Territory, in the New South Wales Southern Tablelands botanical subdivision (sensu Anderson, 1961), part of the South Eastern Highlands IBRA region (Thackway & Cresswell, 1995). It grows along the Murrumbidgee River, where it is as yet only known from the Pine Island area in the Murrumbidgee Corridor Nature Reserve. Only seven plants of the species are known, all from a riparian association on the eastern bank of the river at an altitude of c. 560 m.

Landform, geology and substrates: The plants occur on river bank terraces prone to occasional flooding, and on an adjacent gentle slope. This section of the river is typified by rapids, sand reaches and boulders, with uneven rocky flood terraces, some up to c. 100 m wide, at 2–8 m above normal river level. Downstream of Pine Island the river forms rugged gorges. The higher surrounding terrain is gently sloping, open and undulating.

The underlying geology (1: 100 000 geological map; BMR/AGSO sheet Canberra 8727) is rhyodacitic ignimbrite of the Silurian Laidlow Volcanic Suite. This formation outcrops along the Murrumbidgee River from Tharwa to a few kilometres downstream of Kambah Pool and encompasses the whole study site. It includes small occurrences of volcanoclastic and marine epiclastic sediments.

Muehlenbeckia tuggeranong grows in medium to coarse-textured alluvium, mainly quartzitic sand and gravel, with local richer pockets of silty sand soil. Soils around all plants have a low organic content. The species also grows in crevices amongst larger rock outcrops.

Climate: The Canberra area experiences annual average temperature ranges of 6.3°C minimum and 19.4°C maximum, and a mean annual rainfall of 631 mm (Canberra Airport Climatological Data 1996 — some kilometres from Pine Island). Frosts are common between April and November, with temperatures occasionally down to 10°C.

Associated vegetation: *Muehlenbeckia tuggeranong* is found in a disturbed riparian shrub and woodland association, heavily invaded by exotic weeds. The patchy, open tree layer comprises remnant native species and introduced willows. Understorey varies from densely vegetated to open with scattered grasses and shrubs, with areas of bare rock and sand. *Muehlenbeckia tuggeranong* is found both in exposed situations in crevices on nearly bare rock, or tangled amongst other vegetation.

Associated species (* indicating introduced taxa) include *Casuarina cunninghamiana* Miq. subsp. *cunninghamiana*, *Kunzea ericoides* (A.Rich.) J.Thompson, *Acacia dealbata* Link, *Grevillea juniperina* R.Br. subsp. *nov.* (known as the 'Canberra form'), **Salix alba* L., *Lythrum salicaria* L., **Rosa rubiginosa* L., **Verbascum thapsus* L., **Oenothera* sp., **Echium vulgare* L., **Foeniculum vulgare* Miller, **Plantago lanceolata* L., **Rumex crispus* L., **Hypericum perforatum* L., **Hypochaeris radicata* L., *Typha domingensis* Pers., **Cyperus eragrostis* Vahl, *Isolepis* sp., *Poa labillardierei* Steudel, *Notodanthonia racemosa* (R.Br.) Zotov var. *racemosa*, *Dichelachne micrantha* (Cav.) Domin, **Phalaris aquatica* L., *Phragmites australis* (Cav.) Steudel, **Eragrostis curvula* Nees, **Holcus lanatus* L., **Cynodon dactylon* (L.) Pers. **Rubus* spp. (Blackberry) also occurs nearby.

Flood regime: The site is prone to occasional inundation by major floods, although seasonal snow-melt inflows to the river have been reduced since the building of Tantangara Dam in the 1950s. The last flood to have inundated levels on which at least three of the known plants occur was in 1991. The sole female plant was probably inundated by a smaller flood in 1994 (J. Bros, pers. comm.). The plants are situated 1.5–8 m above normal summer river levels.

Fire regime: The general area was reportedly subject to frequent fire-hazard reduction burns for many years until about 1987 (L. Margules, pers. comm.). Small-scale managed burns of *Phragmites australis* stands in the riparian zone are still carried out in winter. Wildfire, mostly anthropogenic, has also occurred frequently, but is seldom of high intensity and rarely reaches the current *Muehlenbeckia tuggeranong* habitat (J. Bros, pers. comm.).

Comparison with habitat of *Muehlenbeckia axillaris*: The closely related *Muehlenbeckia axillaris* occurs in the Northern and Southern Tablelands botanical subdivisions of New South Wales, and in Victoria, Tasmania and New Zealand. In mainland Australia, *Muehlenbeckia axillaris* occurs at higher altitudes, the nearest known location being near Googong Reservoir at 680 m a.s.l., but elsewhere in New South Wales at 770–1200 m. *Muehlenbeckia axillaris* has similar habitat preferences to *Muehlenbeckia tuggeranong*, growing on damp rocky slopes and river flood terraces, where it can be found exposed or matted amongst other plants.

Conservation

Population status and threat processes: The population comprises seven plants (one female, six male) scattered over c. 1.2 km of riverside. No other populations are known, despite searches by us and others over much of the Murrumbidgee Corridor Reserve system from the Angle Crossing area (Gigerline Nature Reserve) to 2 km below Kambah Pool. Searches included higher, drier slopes, some of which retain substantially intact native vegetation. The plant is easily overlooked, but is clearly very rare in the area of occurrence.

The riverside habitat is much disturbed, by flooding and by human impacts (grazing, weeds, altered fire and flood regimes). There is much apparently suitable habitat, seemingly with many opportunities for establishment and growth. The paucity of

plants found suggests natural rarity, although large population fluctuations may be possible. Using Rabinowitz's (1981) seven types of rarity, *Muehlenbeckia tuggeranong* can be provisionally classified as 'constantly sparse and geographically restricted to a specific habitat'.

Five individuals are under possible threat from competing vegetation. The naturalised weeds **Hypericum perforatum* (St. John's Wort) and **Eragrostis curvula* (African Love Grass) are abundant and highly aggressive. The native shrub *Kunzea ericoides* (Burgan) and the reed *Phragmites australis* (Common Reed) are closely associated with at least three plants and may outcompete or outshade them. Others of concern include **Rubus* spp. (Blackberry species) and **Salix* spp. (Willow species).

Agricultural grazing poses no current problem as it has not occurred on site for at least 23 years (J. Bros, pers. comm.). Sheep grazing occurs on neighbouring properties abutting the corridor reserve, but *Muehlenbeckia tuggeranong* has not been sighted at these drier sites away from the river. Herbivores such as grey kangaroos, hares and rabbits are present in the reserve area, but it is not known whether they feed upon the *Muehlenbeckia*; no obvious signs of browsing have been observed.

Some effects of floods such as substrate disturbance and debris deposition may constitute a threat process to individuals, and given the tiny size of the population may constitute a major stochastic threat to the species. Nevertheless, periodic disturbance may also be beneficial in providing more opportunities for establishment of propagules.

The habitat is adjacent to a developed and intensively used recreation area. About 80 000 vehicles and 190 000 people visit Pine Island annually (J. Bros, pers. comm.). Associated risks include trampling (especially a problem for the only known female plant, which is located on an informal foot-track), further clearing or track development, soil compaction, and deliberate or accidental fire. Some modification of drainage due to establishment of roads, car parks and picnic areas has clearly occurred, although impact on the species is not known. Potential chemical contamination of parts of the habitat through motor oil and fuel runoff is of some minor concern, and increased nutrient inputs, including reported occasional overflows from nearby toilet blocks (D. Dempster, pers. comm.) may encourage growth of competing weeds.

Weed invasion and weed control methods are both potential problems. Exotic and native species of particular concern are noted above. The ACT Parks & Conservation Service have conducted spraying and slashing of weed species in the area, particularly **Rosa rubiginosa* (Sweet Briar), **Rubus* spp. (Blackberry) and **Hypericum perforatum* (St John's Wort). Most chemical weeding has been on the margins of mown areas and toilet blocks, but some has been closer to the river in areas near the *Muehlenbeckia*. Applications of glyphosate ('Round-up') and metsulfuron methyl ('Brush-off') were conducted in October 1996. Chemical weed management has increased in recent years as part of more intense management of the area. Accidental application of herbicide is a potential direct threat to *Muehlenbeckia tuggeranong*, but management of competing vegetation is probably essential to the survival of the few known plants.

Ex-situ propagation: Cutting material from five plants was taken in early 1997 for propagation at the Australian National Botanic Gardens, Canberra. Nine punnets of cuttings were divided among three different hormone treatments (2000 mg/l potassium-based indole butyric acid, 4000 mg/l gel-based indole butyric acid, 1600/1600 mg/l ethanol-based indole butyric acid, all carried in naphthalene and acetic acid), and a total of 109 cuttings processed. Standard propagation mix of five parts perlite and one part peat was used as the striking medium. Most cuttings carried galls of the eriophid mite.

Propagation of the female plant with the potassium-based hormone proved most effective, with a 75% strike rate; the other two hormone treatments each yielded a 42% strike rate. Male plant cuttings propagated slightly later yielded a 33% strike rate with the gel-based hormone, whilst the other two both gave a 53% strike rate. It should be noted that a control set (no hormone treatment) was not used, and environmental conditions were not rigorously standardised.

Struck plants remain healthy at July 1998, with no obvious adverse effects from the eriophid gall infestations, which remain present. Some plants have been seen to sucker from the bottom of the pot. The five clonal lines struck are being maintained in the permanent collection, and 30–40 plants (including females) have been planted out at the ANBG.

Conservation coding: Further searches of likely habitat are essential before a final rarity and threat status can be decided. The small size of the known population and its very restricted geographic extent make it very vulnerable to stochastic events.

Under the ROTAP criteria (Briggs & Leigh, 1996) an interim and precautionary conservation coding of 2Ect is recommended (where 2 = small population with geographical range of less than 100 km; E = endangered; C = present in a conservation reserve and t = total known population reserved). Under the IUCN Red List criteria (IUCN, 1994), the species qualifies for a coding of CR (Critically Endangered), satisfying criteria B and B1 (area of occupancy < 10 km², single location), arguably C2 (projected decline, single subpopulation), and D (< 50 individuals). No data are available on actual population dynamics, to assess against other criteria, and to date no quantitative analysis has been performed as to probability of extinction (criterion E).

Management recommendations: Serious threats to *Muehlenbeckia tuggeranong* include weed competition, herbicide poisoning, and human physical impact (trampling and other forms of damage). Of lesser concern are herbivory, and factors associated with runoff from developed areas. The tiny population size, and apparent lack of recruitment, make the species highly vulnerable, even to stochastic extinction through processes (such as fire and flood) that may in other respects be beneficial. Conservation efforts must address these issues and provide protection within reason.

Further control of competing plants, especially exotics, is needed. Alternative methods to herbicide spraying, such as cut and dab and mechanical removal, should be employed in the vicinity of *Muehlenbeckia* plants, to reduce the risk of spray drift.

Human impact will always be a problem for *Muehlenbeckia tuggeranong* at this site, as Pine Island is a popular recreational area. Public relations, education and protective fencing should be considered as management options.

A monitoring and recovery plan is needed. This should include as an urgent priority further intensive surveys of the middle reaches of the Murrumbidgee R. from the Bredbo area downstream to Burrinjuck Reservoir, and especially along the stretches of river bounded to the west by the Clear and Bullen Ranges. If surveys confirm the rarity of the species, a research program should be developed to analyse genetic variability, breeding system, and response to disturbance. The species and its closest congener are ideally situated for development of local university projects in concert with a recovery plan. Subject to the survey outcomes, further precautionary ex-situ propagation is desirable, and depending on research outcomes enhancement planting back into the wild may eventually be justified.

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