**Approved Recovery Plan**

# Recovery Plan for the threatened Alpine Flora - Anemone Buttercup (*Ranunculus anemoneus*), Feldmark Grass (*Erythranthera pumila*), Raleigh Sedge (*Carex raleighii*) & Shining Cudweed (*Euchiton nitidulus*)

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**Cover photograph:** Anemone Buttercup (*Ranunculus anemoneus*)
**Photographer:** Colin Totterdell

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# Recovery Plan for the threatened Alpine Flora - Anemone Buttercup (*Ranunculus anemoneus*), Feldmark Grass (*Erythranthera pumila*), Raleigh Sedge (*Carex raleighii*) & Shining Cudweed (*Euchiton nitidulus*)

## Executive Summary

This document constitutes the formal New South Wales State Recovery Plan for the threatened Alpine Flora Anemone Buttercup (*Ranunculus anemoneus*), Feldmark Grass (*Erythranthera pumila*), Raleigh Sedge (*Carex raleighii*) and Shining Cudweed (*Euchiton nitidulus*), and as such considers the conservation requirements of the four species across their known range. It identifies the actions to be taken to ensure their long-term viability in nature and the parties who will carry these out.

All of the species occur entirely within Kosciuszko National Park. Only *Ranunculus anemoneus* is currently known from within the ski resort lease areas, although most populations of this species apparently occur outside. It is possible that the other species considered in this Plan also occur within the resort lease areas.

Raleigh Sedge is listed as Endangered (Schedule 1, Part 1) in New South Wales under the *Threatened Species Conservation Act 1995*. The other species are listed as Vulnerable (Schedule 2) under the TSC Act. Feldmark Grass, Shining Cudweed and Anemone Buttercup are also listed as nationally Vulnerable under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999.*

The recovery actions detailed in this recovery plan are (i) survey of suitable habitat for further populations of three species (Anemone Buttercup, Raleigh Sedge and Shining Cudweed), and, (ii) monitoring of trampling effects on Feldmark Grass and insect damage on Shining Cudweed.

It is intended that this recovery plan will be implemented over a three year period using the existing resources of NPWS. The cost of actions identified in the Plan is $14,350.

**Brian Gilligan**
**Director-General**

**Bob Debus**
**Minister for the Environment**

## Acknowledgments

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# 1 Introduction

The biota of the alpine areas of Australia is recognised as having National significance (eg. Costin *et al.* 1979; Good 1988). In Victoria, almost 60% of plant species occurring in alpine vegetation are restricted to high mountain areas (McDougall 1997). More than 10% of that State's flora can be found in the alpine treeless plains despite occupying less than 1% of State's land area.

In New South Wales, the percentage of altitudinal endemism is likely to be greater than in Victoria because of the larger number of local endemics here. The altitudinal restriction of plants and the small area occupied by alpine vegetation mean that many alpine species are rare or at least extremely localised. Accordingly, 34 plant species of the alpine area of Kosciuszko National Park are recognised as rare or threatened by Briggs and Leigh (1996). Four of these species (Anemone Buttercup (*Ranunculus anemoneus*), Feldmark Grass (*Erythranthera pumila*), Raleigh Sedge (*Carex raleighii*), and Shining Cudweed (*Euchiton nitidulus*)) are listed under the *Threatened Species Conservation Act 1995* (TSC Act). They are the collective subject of this recovery plan.

# 2 Legislative Context

## 2.1 Legal Status

Raleigh Sedge is listed as Endangered in New South Wales (Schedule 1, Part 1 of the TSC Act). The other species are listed as Vulnerable (Schedule 2 of the TSC Act). Feldmark Grass, Shining Cudweed and Anemone Buttercup are also listed as nationally Vulnerable under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Raleigh Sedge is not listed under the ESP Act. In Victoria, Raleigh Sedge and Shining Cudweed are regarded as rare and vulnerable respectively (Gullan *et al.* 1990).

## 2.2 Recovery Plan Preparation

The TSC Act requires that the Director-General of the National Parks and Wildlife Service prepare recovery plans for all species, populations and ecological communities listed as endangered or vulnerable on the TSC Act schedules. The TSC Act includes specific requirements for both the matters to be addressed by recovery plans and the process for preparing recovery plans. This plan satisfies these provisions.

## 2.3 Recovery Plan Implementation

The TSC Act requires that a government agency must not undertake actions inconsistent with a recovery plan. The only State government agency relevant to this plan is the NPWS. Consequently, the NPWS must, as the relevant manager, manage the threatened alpine flora within Kosciuszko National Park in accordance with this plan.

## 2.4 Relationship to Other Legislation

The lands on which the threatened alpine flora occurs include those that are owned or managed by the NPWS. Relevant legislation includes:

- *National Parks and Wildlife Act 1974*
- *Environmental Planning and Assessment Act 1979*
- *Rural Fires Act 1997*
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The interaction of these Acts with the TSC legislation is varied. The most significant implications are described in Section 2.6.

The EPBC Act specifies that a Commonwealth agency must not take any action that contravenes a Recovery Plan.

## 2.5 Critical Habitat

The TSC Act makes provision for the identification and declaration of Critical Habitat. Under the TSC Act, Critical Habitat may be identified for any endangered species, population or ecological community occurring on NSW lands. Once declared, it becomes an offence to damage Critical Habitat (unless the action is exempted under the provisions of the TSC Act) and a Species Impact Statement is mandatory for all developments and activities proposed within declared Critical Habitat.

To date, Critical Habitat has not been declared for any of the alpine flora under the TSC Act. The declaration of critical habitat is not considered to be a priority for any of the species, as other mechanisms provide for the protection of this species. As the habitats of the four species in NSW are only known to occur on land managed by the NPWS, the type of developments or activities which are likely to occur are limited by the provisions of the NPW Act. Critical habitat for these species will not be assessed in the life of this plan.

Under the EPBC Act, Critical Habitat may be registered for any nationally listed threatened species or ecological community. When adopting a Recovery

Plan the Federal Minister for the Environment must consider whether to list habitat identified in the Recovery Plan as being critical to the survival of the species or ecological community. It is an offence under the EPBC Act for a person to knowingly take an action on a Commonwealth area that will significantly damage Critical Habitat (unless the EPBC Act specifically exempts the action). Although this offence only applies to a Commonwealth area, any action that is likely to have a significant impact on a listed species occurring within registered Critical Habitat on other areas is still subject to referral and approval under the EPBC Act. Proposed actions within registered Critical Habitat on non-Commonwealth areas are likely to receive additional scrutiny by the Commonwealth Minister.

## 2.6 Environmental Assessment

The TSC Act amendments to the environmental assessment provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act) require that consent and determining authorities (the Director-General of the NPWS in the case of NPWS estate) consider relevant recovery plans when exercising a decision making function under Parts 4 & 5 of the EP&A Act. Decision makers must consider known and potential habitat, biological and ecological factors, and regional significance of individual populations.

The only public authority that has a decision making function in relation to the threatened alpine flora is the NSW NPWS. Activities as defined under the EP&A Act require the approval of the Director-General. Any other action not requiring approval under the EP&A Act, and which is likely to have a significant impact on the threatened alpine flora, requires a Section 91 licence from the NPWS under the provisions of the TSC Act. Such a licence can be issued with or without conditions, or can be refused.

Additional public authorities may have a decision making function if the species are located in other areas in the future.

The EPBC Act regulates actions that may result in a significant impact on nationally listed threatened species and ecological communities. It is an offence to undertake any such actions in areas under State or Territory jurisdiction, as well as on Commonwealth-owned areas, without obtaining prior approval from the Commonwealth Environment Minister. As three

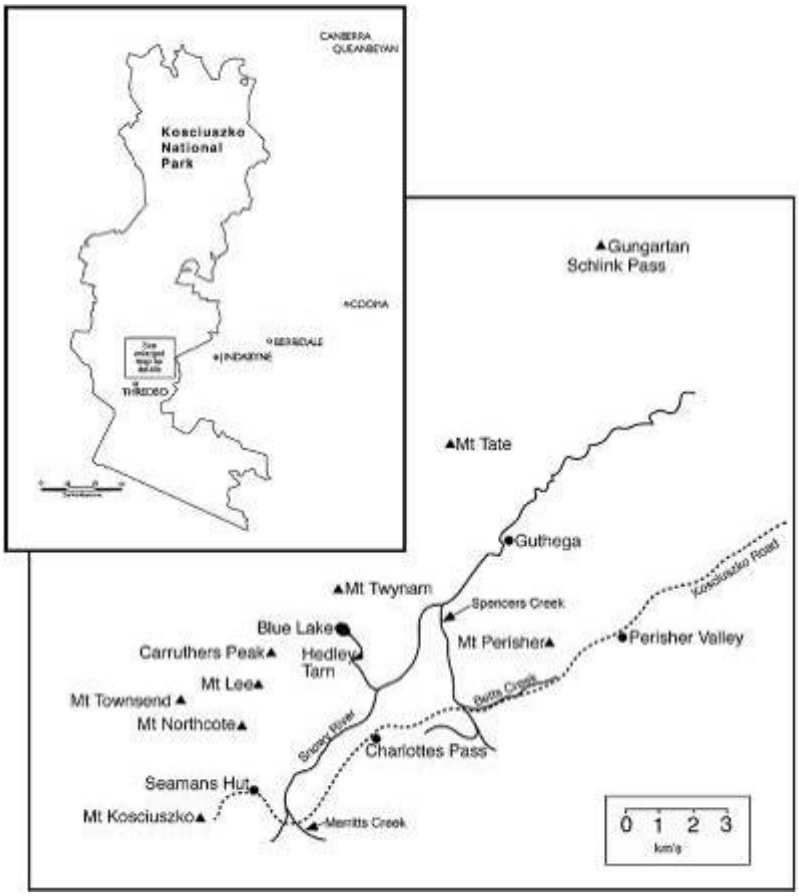


**Figure 1:** General location of the threatened alpine plants and place names referred to in this recovery Plan

of the threatened alpine species are listed nationally under the EPBC Act, any person proposing to undertake actions likely to have a significant impact on these species should refer the action to the Commonwealth Minister for the Environment for consideration. The Minister will then decide whether the action requires EPBC Act approval. Administrative guidelines are available, from Environment Australia, to assist proponents in determining whether their action is likely to have a significant impact

The Environment Minister can also delegate the role of assessment and approval to other Commonwealth Ministers under a Ministerial Declaration, and to the States and Territories under bilateral agreements. At the time of writing the bilateral agreement between NSW and the Commonwealth has not been completed, but when in place the agreement will avoid the need for duplication of environmental assessment.

## 3 Land Tenure

All four species occur entirely in Kosciuszko National Park. The Anemone Buttercup is found within ski resort lease areas. There is an unconfirmed record of Feldmark Grass from within a resort lease area and it is possible that the other two species considered will be found in resort lease areas. Regardless of this, the majority of populations appear to be outside resort lease areas.

## 4 Species Information

### 4.1 Anemone Buttercup (*Ranunculus anemoneus* F.Muell.)

*Description and Distribution*

The Anemone Buttercup (family Ranunculaceae) is a robust, shortly rhizomic perennial herb. Its basal leaves are large (to 8 cm wide), leathery and deeply cleft into multiple spreading lobes. Stem leaves are stalkless and clasping. Flowers are creamy white and large compared with other alpine ranunculi (to 6 cm in diameter). The numerous fruits, which are densely clustered in a head to 1.5 cm in diameter, have a prominent beak (to 2 mm long). Plants flower soon after snow melt. A more detailed description can be found in Costin *et al.* (1979).

Collection Records

Excluding duplicates, 55 collections of the Anemone Buttercup are held in the major herbaria of New South Wales and the Australian Capital Territory (the ACT). Eight of these collections were made last century. The majority (38) have been made since 1951 (including 17 in the past 20 years). There are a further 42 records of the Anemone Buttercup in the Kosciuszko National Park database.

The lineal range of the species is approximately 32 km. It occurs in a narrow band (of about 8 km wide) along the Great Dividing Range. Within its range, the Anemone Buttercup occurs in six somewhat disjunct areas: the Main Range between Mt Kosciuszko and Mt Twynam (which contains most records); the Charlottes Pass resort; the Mt Perisher - Mt Blue Cow area; the Guthega - Mt Tate area; the Schlink Pass - Gungarten Pass area; and a single record from South Rams Head. Most records are from above the limit of tree growth (the alpine zone, ie. > 1900 m), although there are a few records from at or just below the treeline (to as low as 1600 m).

The Anemone Buttercup was recorded by James Stirling at Mt Hotham in Victoria last century. Despite extensive surveys of Mt Hotham (and surrounding alpine peaks), the species has not been relocated. The record of Stirling is either wrong or the species has become extinct in Victoria (Walsh and Entwisle 1996).

Confirmed Populations

It is not known how many populations are represented by the 97 records for the species or how many of them survive. The locations given with the records fall within 43 1 x 1 km AMG grid squares. In a limited survey of Anemone Buttercup sites in January 1997 by Hazel Rath (as part of a Masters project at the University of New England), 23 extant populations were located. When other post-1980 records with accurate location details are considered, there are an additional nine populations, which were not recorded by Rath. There are therefore likely to be at least 32 extant populations of Anemone Buttercup. The species is noted as scattered and occasional in three post-1980 herbarium records, as locally frequent in another three and as common in another two.

*Habitat and Ecology*

Costin *et al.* (1979) note that the Anemone Buttercup is "locally common near snow patches both in short alpine herbfield and along snow-melt streams in tall alpine herbfield, also in rock crevices in *Coprosma-Colobanthus* feldmark". Habitat notes accompanying herbarium records suggest that the species generally occurs in environments with late melting snow (south to east facing, steep grassy slopes, rocky crevices, and short alpine herbfields). The species has also been collected along watercourses, in grassland, heathland (below snowpatches) and on roadside batters. Soils at Anemone Buttercup sites include loams (alpine humus soils), peats and decomposing granite.

Despite its attractive appearance, little appears to be known about the biology and ecology of the species. It is probably palatable to domestic stock and therefore grazing-sensitive. A related alpine species, *Ranunculus victoriensis*, was found to be cropped and to have been eaten by cattle on the Bogong High Plains (van Rees 1984). Part of the reason for the susceptibility of Anemone Buttercup to grazing might be its early flowering. Species in the high country that flower soon after snow melt form their flower buds in the autumn before flowering. This is true of most alpine shrubs and some forbs such as *Caltha introloba* (McDougall 1997) and undoubtedly the Anemone Buttercup. Grazing of Anemone Buttercup flower buds in autumn could significantly impact on populations if plants are short-lived.

Research on the pollination of the Anemone Buttercup is being conducted by Hazel Rath at the University of New England.

*Threats*

Grazing by domestic animals until the 1950's apparently had a drastic effect on the spatial and temporal distribution of the Anemone Buttercup. The following quote from Totterdell (1984) sums up the changes that occurred:

*After the great botanist / explorer Ferdinand Mueller (later Baron von Mueller), visited Kosciusko in the summer of 1854-55 he wrote: "One of the most remarkable (plants) is assuredly a large-flowering Ranunculus with generally numerous and almost white petals having much the habit of an Anemone. It grows seldom below 6,000 ft. chiefly on springs and on the margins of melting snow." Forty-five years later, J. H. Maiden, N.S.W. Government Botanist, commented: ".... the observation as to its habitat would appear to be scarcely correct. It seems to prefer crevices of granite boulders."* Although *Maiden's observations were later in the season when the main flowering of the species was over ..... its distinctive foliage ..... would have been fairly obvious had it been growing along the streams below the snow patches. It is more likely that both observers were right. By the time Maiden went to Kosciusko, stock had been grazing above the treeline for many decades, drastically reducing the habitat of this wonderful plant.*

At the time stock grazing ceased in the Kosciuszko area in the late 1950s, the Anemone Buttercup was close to extinction (Costin *et al.* 1979). The photographer for the Kosciusko Alpine Flora, Colin Totterdell, could only find one flowering plant to photograph on his first visit to the Kosciuszko area in the early 1960s (C. Totterdell, pers. comm.). In the past 35 years the species has flourished and can now be found in a range of habitats, much as Ferdinand Mueller described in the 1850s.

Although the species may also be palatable to native herbivores, large herbivores such as macropods are scarce in the alpine zone of mainland Australia and unlikely to have an impact on this grazing-sensitive species. Rabbits, which appear to have become more common in the Kosciuszko high country in the past decade (Linda Broome, NPWS, pers. comm.), may be a future threat to the Anemone Buttercup if the plant is a preferred component of their diet.

The Anemone Buttercup occurs in the Charlottes Pass and Perisher Blue ski areas. Developments such as slope grooming and the expansion of ski run and accommodation facilities, and skier use of slopes in marginal snow conditions might impact on populations. The potential impact of ski development on the species may be greater than would be expected if the species was evenly distributed in the landscape because both ski resorts and the Anemone Buttercup have a preference for snow-retaining slopes. Although the impact within resorts of developments is assessed in routine development applications, a greater use of resorts in summer may have an impact on populations beyond resort boundaries.

Picking of the spectacular flowers of the Anemone Buttercup by tourists may occur. However, since most populations are some distance from walking tracks, flower picking is probably a minor threat to the species overall.

Although the Anemone Buttercup is unlikely to be significantly threatened by any of the above activities during the period covered by this Plan and no actions are immediately necessary to ameliorate the threats, long term population trends in the species are worth investigation to ensure that it does not again approach extinction.

*Previous Actions Undertaken*

NPWS supported a project to relocate Anemone Buttercup populations in 1996. A graduate student, Hazel Rath, conducted the searches as a preliminary part of a MSc thesis with the University of New England.

### 4.2 Feldmark Grass (*Erythranthera pumila* (Kirk) Zotov)

*Description*

Feldmark Grass is an inconspicuous tufted grass (family Poaceae). Its leaves grow to only about 3 cm high and its flowering stems to about 7 cm high. The leaves have broad papery sheaths and are often curved or spirally twisted. The inflorescence is longer than the leaves. The 2-4 spikelets, which are held against the

flowering stem, each contain 2-4 flowers. Unlike most other grasses, the flowers are completely enclosed by the glumes (small leafy bracts at the base of each spikelet). The lemma (which partly encloses the flower within the glumes) has hairs scattered over the outer surface and a minute central bristle in a notch at the apex. Feldmark Grass differs from the only other species of that genus (*Erythranthera australis*) in its longer spikelets, lance-shaped glumes and hairy lemmas. More complete descriptions and illustrations can be found in Mark and Adams (1973) and Costin *et al.* (1979). This species has recently been renamed *Rytidosperma pumilum* (Linder 1997) but is still listed as *Erythranthera pumila* in the Schedules of the TSC Act.

*Distribution in NSW*

Collection Records

Eight non-duplicate Australian collections of Feldmark Grass have been lodged in herbaria in NSW and the ACT. The first collection was made in 1949 by the visiting Swedish botanist, Professor Carl Skottsberg. Before this, the species was regarded as a New Zealand endemic. All of the Australian collections list the location as one of the following: Lake Albina area; Mt Lee; Mt Northcote; or Northcote Pass. This is a very narrow geographic distribution.

Two other populations have been reported but not confirmed with voucher specimens. One is on a permanent monitoring transect below Seaman's Hut near Mt Kosciuszko (Dane Wimbush, CSIRO (retired), pers. comm.) and the other is near Charlotte's Pass (Mallen-Cooper and Mallen-Cooper 1988).

Feldmark Grass is more common in New Zealand, where it is "widespread in the drier interior and eastern regions" of the high mountains of the South Island (Mark and Adams 1973). Its recent discovery and isolated occurrence in Australia may be suggestive that it is a recent arrival, although there is no indication that it is a weed.

The mixing of alpine floras in the Australasian region has been flagged as a possible consequence of the increasing mobility of humans and the popularity of mountains as tourist destinations (McDougall and Appleby 2000). Already, another New Zealand alpine species, *Uncinia sinclairii*, which is only found in Australia at one site near Mount Kosciuszko, has been regarded as a weed here (Hnatiuk 1990). This evaluation may be ill-considered, however. Australia and New Zealand have many alpine species in common. Of the 190 vascular plants featured in the Kosciuszko Alpine Flora (Costin *et al.* 1979), 35 also occur in New Zealand. Some species in common are widespread, some are rare and some extend into lowland areas.

Barlow (1989) proposes that the Australian alpine flora has developed largely through speciation following long-distance dispersal of species, principally between southern hemisphere mountain regions and particularly assisted by birds. Exchange of species between alpine areas of Australia and New Zealand probably occurs very infrequently, however. When exchange does occur, the recently arrived species may be extremely rare and localised for some time. It is perhaps for this reason that seven alpine species that have extra-Australian distributions are listed as rare or threatened (Briggs and Leigh 1996) - for instance *Euchiton nitidulus* in this plan.

Confirmed Populations

A survey of the areas where Feldmark Grass has been reported to occur (excluding the Charlottes Pass record, which was not known at the time) was conducted by Keith McDougall and Genevieve Wright (NSW NPWS) on the 12th of February 1998. The species could not be relocated at the two locations where it had been recorded along the transect below Seaman's Hut, despite precise distances (to 1 cm) along the transect having been provided by Dane Wimbush. The habitat of the Seamans Hut and Charlottes Pass records is likely to support the very similar species *Erythranthera australis*. It is possible that Feldmark Grass was mis-identified at these two sites.

The species was relocated in the Northcote Pass area. It appears that there is a single population in this area, extending along the ridge top from the Mt Northcote side of Northcote Pass to the summit of Mt Lee, a distance of about 1 km. The site containing the plants ranges from about 20 m to 60 m wide. The total area is about 3 ha. The population at the site was roughly estimated along three transects to be more than 5,000 plants (and perhaps as many as 30,000 plants). The precise number will be difficult to determine because an individual may be indeterminate. Mark and Adams (1973) note that the species is rhizomic.

Unsuccessful searches were subsequently made of vegetation that is similar to that found in the Northcote Pass area. This included all areas mapped by Costin *et al.* (1979) as feldmark vegetation. Although these communities contain abundant unvegetated surfaces, which are presumably suitable for establishment, no further plants were found.

*Habitat and Ecology*

The plant community to which the species may be restricted in Australia is called feldmark (a Norwegian name simply meaning *mountain field*). Costin *et al.*

(1979) describe two types of feldmark, the *Epacris* - *Chionohebe* alliance and the *Coprosma* - *Colobanthus* alliance. The former, in which Feldmark Grass is found, occurs mainly on exposed ridges and summits. Because of persistent low temperature and strong wind, few species occur in this feldmark vegetation. Some species are restricted to *Epacris* - *Chionohebe* feldmark. Plants in this vegetation are short and plant cover is sparse. Soils are lithosols and most ground cover is provided by fractured rock.

Feldmark community near Carruthers Peak showing the pattern of *Epacris microphylla* sens. lat. shrubs growing on a stony erosion pavement. The shrubs move slowly across the ridges because of damage to plants from wind on the windward side and layering on the leeward side. *Photo: Colin Totterdell*

Plant species associated with Feldmark Grass in the *Epacris* - *Chionohebe* feldmark vegetation between Northcote Pass and Mt Lee include: *Agrostis muelleriana, Brachyscome* sp., *Chionohebe densifolia* (ROTAP 2RC-t+), *Colobanthus pulvinatus* (ROTAP 2RC-t), *Drapetes tasmanicus, Epacris microphylla* sens. lat., *Epilobium tasmanicum, Euphrasia* sp., *Ewartia nubigena, Leucochrysum albicans* subsp. *alpinum, Luzula oldfieldii* subsp. *dura, Lycopodium fastigiatum, Poa fawcettiae, Ranunculus muelleri* var. *brevicaulis, Rumex acetosella, Senecio pectinatus,* and *Trisetum spicatum* (feldmark form). Species noted by Costin *et al.* (1979) in similar feldmark vegetation include: *Colobanthus affinis, Epacris petrophila, Euphrasia alsa* (ROTAP 2RC-), *Euphrasia collina* subsp. *lapidosa, Oreomyrrhis brevipes* (ROTAP 3RC-), *Pentachondra pumila,* and *Scleranthus singuliflorus.*

To our knowledge, nothing has been published specifically on the ecology of Feldmark Grass, although, judging from its habit, distribution and preferred habitat, it presumably resprouts following disturbance, is remarkably tolerant of low temperature and has a limited capacity for dispersal of seeds to other areas of similar habitat nearby.

The only confirmed vegetation type containing Feldmark Grass in Australia is feldmark. Feldmark occurs mainly on exposed ridgetops, which have little soil development and abundant fractured rock. There is little snow cover in winter because the prevailing westerly winds blow it off into lee snow patches. The absence of snow cover means that extremely low temperatures and strong winds are experienced for long periods during winter. Surface soil temperatures are high in summer and soil moisture levels are often limiting at that time. Few plant species are able to survive under these conditions. As a result, plant cover is sparse.

Barrow *et al.* (1968) have documented the cyclical changes that occur in the feldmark plant community. The prevailing westerly winds damage and kill the windward facing parts of the dominant shrubs of *Epacris microphylla* sens. lat. and *E. petrophila*. Fine material gathers on the sheltered side of shrubs, which facilitates spread of the shrubs to the lee through layering. The *Epacris* clumps effectively move across the ridgetops, at a rate estimated by Barrow *et al.* (1968) to be about 1 cm per year. The distribution of some other feldmark species seems to be closely linked with this cycle of death and regeneration, with plants often growing amongst live or dead branches rather than amongst rock. The distributions of Feldmark Grass and the dominant shrubs are not obviously related, although further study of species inter-relationships is warranted because the community contains several rare species and recovery actions could potentially interfere with these cycles.

A section of raised walkway has been placed in a feldmark stand that does not contain Feldmark Grass to monitor its effect on feldmark vegetation. It is not yet clear if these structures interrupt natural processes. They may cause local changes in vegetation, however, by ameliorating conditions beneath and on the lee side of the structures.

*Threats*

The walking track circuit on the Kosciuszko Main Range bisects the feldmark containing the Feldmark Grass population. Although there is a distinct track through the feldmark, traffic is often dispersed

because the feldmark surface is uniformly rocky, sparsely vegetated and views are best obtained by leaving the track. There is unlikely to be duplication of tracks through track entrenchment because the track is already on rock and erosion is negligible. Trampling in itself is unlikely to damage a significant proportion of the Feldmark Grass population at present levels of use. Trampling does, however, damage *Epacris* shrubs and dead branches are sometimes collected by walkers for their polished driftwood appearance. The effect of interrupting the feldmark shrub cycles is unknown. Presumably, trampling will hasten the death of shrubs on the windward side and inhibit the regeneration of shrubs on the leeward side. Ultimately, but perhaps only after some hundreds or thousands of years because of the slow nature of the process, the dominant shrubs might disappear from the leeward side of the walking track. Trampling may effect any species with a regenerative dependence on the shrub cycle.

There may also be unquantifiable threats to the species from predicted changes in climate. Long-term changes in snow cover, winter temperatures and wind strength or direction may effect the species, although it is difficult to know in what way. Many of the threats to Feldmark Grass seem minimal at present, although future increases in summer use of the alpine area may adversely affect the feldmark communities. Feldmark Grass deserves threatened status mainly because it is found in only one population. In general, species with a single population are likely to be more prone to extinction from rare and unexpected catastrophic events than species with many populations.

*Previous recovery actions*

Approximately three person days have been spent on field searches for the species in places where it has been recorded and in similar habitat. All *Epacris* - *Chionohebe* feldmark communities mapped by Costin *et al.* (1979) have now been searched.

## 4.3 Raleigh Sedge (*Carex raleighii* Nelmes)

*Description*

The Raleigh Sedge is a rhizomatous, perennial herb (family Cyperaceae), which grows to about 25 cm tall. Its leaves are less than 1 mm wide, flat and wiry. Flowering culms are also distinctively thin and wiry. The 1-5 flowering spikes are clustered towards the end of the culm but far exceeded by a leaf-like bract. Unlike some other sedges, the flowering head does not have a male spike. Utricles (the sacs enclosing the fruit) are 3 mm long. The Raleigh Sedge is very similar in appearance to *Carex hebes*, another alpine species. It differs from *C. hebes* in having narrower leaves, longer, narrower culms and shorter utricles. Illustrations and descriptions of the Raleigh Sedge can be found in Walsh and Entwisle (1994) and Kirkpatrick (1997).

*Distribution in NSW*

Collection Records

There are three confirmed records of the Raleigh Sedge in New South Wales. Until recently, the species was only known from a single collection by Max Mueller, who was an employee of the Snowy Mountains Authority (Roger Good, NPWS, pers. comm.). The collection was made on the 21st of February 1954 and contained little information about location or habitat ("Head of Tumut River. Swampy valley meadow"). A search of the Kosciuszko National Park herbarium in 1998 located a specimen labelled *Carex hebes*, which has the wiry stems and leaves of the Raleigh Sedge and relatively short utricles. It was collected from the "Tooma headwater region (meadow valley with *Poa caespitosa* var. *latifolia*)" by Max Mueller on the 19th of February 1954. The specimen was recently confirmed by Karen Wilson of the National Herbarium of NSW to be Raleigh Sedge. The other confirmed collection of the Raleigh Sedge in New South Wales was made by Karen Wilson in January 1997 near Spencers Creek below Charlottes Pass. The specimen was lodged at the National Herbarium of New South Wales.

Current Populations

The only population confirmed by the authors to be extant is that at Spencers Creek. This was seen in early February 1998. Only about 20 plants were confidently identified. However, the spring and summer prior to the inspection were amongst the driest on record and many cyperaceous plants in the bog vegetation had not flowered. A tributary of Spencers Creek (Betts Creek) was searched without success. There has apparently been no search for the species in the headwaters of the Tumut or Tooma Rivers. An extensive search of the Spencers Creek area was not made at the time of the 1997 collection (Karen Wilson, National Herbarium of New South Wales, pers. comm.).

*Habitat and Ecology*

The site at Spencers Creek is a broad valley bog on a gentle slope with a patchy cover of the moss, *Sphagnum cristatum*. The dominant plant is *Empodisma minus*, although species such as *Epacris petrophila, Poa costiniana, Carpha nivicola* and *Carex gaudichaudiana* are locally abundant. Soils are peaty, highly acidic and permanently moist. The Raleigh Sedge seems to be most abundant in small cushions of *Sphagnum* at the edge of the bank above the creek.

Most collections of the Raleigh Sedge from other States have been made in bog (especially on creek banks), fen or swampy vegetation at high altitude. A few collections in Victoria are from woodland (*Eucalyptus stellulata* or *Eucalyptus pauciflora*) with a grassy understorey. One Tasmanian collection is from a rocky slope with grassy patches.

Little is known about the response of the species to disturbance. Its rhizomic habit suggests that it will resprout following removal of above-ground material from grazing or burning. Several alpine *Carex* species are commonly grazed by cattle in Victoria (van Rees 1984). Although cattle no longer graze the Kosciuszko area, other herbivores may similarly select species such as the Raleigh Sedge.

*Threats*

Threats to the species in New South Wales are largely unknown and unquantified. The single population observed may be threatened by trampling of people fishing along Spencers Creek. There is already a distinct track along the creek near some of the plants. Actual damage to plants from trampling was not observed and the threat is not believed to be significant at present. If, following further survey, the species was found to be limited to this population, the threat from trampling would need to be more carefully assessed.

*Previous recovery actions*

A survey to relocate the Spencers Creek population was made in early February 1998.

Collections of *Carex hebes* in the Kosciuszko National Park herbarium were checked to determine if any had been mis-identified. One specimen, which was labelled *Carex hebes* but appeared to be *Carex raleighii*, was sent to the National Herbarium of New South Wales for a check of determination.

A request was sent to the Records Manager of the Snowy Mountains Authority for any information held by the Authority about the collections of the species made by Max Mueller. No record of the collections could be found in SMA archives (Heather Elliot, Snowy Mountains Authority, pers. comm.).

## 4.4 Shining Cudweed (*Euchiton nitidulus* (Hook.f.) A.Anderb.)

*Description*

Shining Cudweed (family Asteraceae) is a low, mat-forming perennial daisy, which was formerly known as *Gnaphalium nitidulum*. Its crowded stems are only a few centimeters tall. The densely spaced leaves are beset with shining, silvery hairs on both surfaces. The inflorescence is not a typical petaloid daisy flower. It is solitary on a short (to 3 cm long) woolly stem.

Shining Cudweed is superficially similar to another mat-forming alpine daisy, *Euchiton argentifolius*. The two species are sometimes found growing together. *Euchiton argentifolius* has several floral characteristics that are different to those of Shining Cudweed. When not in flower or fruit it may be possible to distinguish the two species by their old flower stalks, which are much shorter in Shining Cudweed (to 3 cm compared with to 15 cm in *E. argentifolius*). Shining Cudweed also has coarser hairs on its leaves.

More complete descriptions and illustrations can be found in Mark and Adams (1973) and Costin *et al.* (1979).

*Distribution in NSW*

Collection Records

There are perhaps only seven records of Shining Cudweed in New South Wales. This includes four herbarium collections. All of these are in the high alpine region in the vicinity of Mt Kosciuszko (Seamans Hut in 1970, Spencers Creek in 1962, Upper Snowy River in 1972, and Hedley Tarn in 1992). There are also five further records (without voucher) in the Kosciuszko National Park database. Two of these could be from the same locations as herbarium collections. The other three are also from the Kosciuszko alpine area (Carruthers Peak area, Ramshead Range, Merritts Creek).

Shining Cudweed also occurs in Victoria and New Zealand in similarly high mountain areas.

Confirmed Populations

Three of the four sites where herbarium collections had been made were searched on the 4th and 5th of April 1998. The species was relocated at each site. Population estimates were made: Spencers Creek (at least 200 plants); Seamans Hut (about 100 plants); Upper Snowy River (at least 200 plants). Because of the rhizomic nature of Shining Cudweed, it was sometimes difficult to determine the extent of an individual plant. The above estimates were made conservatively (ie. a clump of shoots was counted as a single plant). A more extensive search was made of the Upper Snowy / Merritts Creek areas in February 1999. Merritts Creek is a tributary of the Upper Snowy River. More than 100 plants were counted along two transects in grassland beside Merritts Creek. Only a small portion of the suitable habitat was searched. Many more clumps were also found along the Upper Snowy River. There are probably at least 1000 clumps of Shining Cudweed in the Merritts / Upper Snowy catchment. A further population of at least 100 scattered plants was located in January 2000 above

Lake Cootapatamba in the vicinity of the Mt Kosciuszko – Thredbo walkway.

*Habitat and Ecology*

Costin *et al.* (1979) indicate that the Shining Cudweed is found in "wet areas near streams and near the margins of bogs, and sod tussock grassland". The only herbarium collection of a New South Wales population that includes habitat information was from a "steep slope, N aspect. Stony, peat on granite" with "alpine shrubs, *Kunzea*, *Hovea*, *Aciphylla*, *Baeckea*, *Leucopogon*, etc.". Victorian populations have been recorded in grassland and open heathland.

The Spencers Creek and Snowy River populations occur in short, open *Poa costiniana* / *Danthonia nudiflora* grassland. The inter-tussock spaces of the grassland are herb-rich. Species commonly occurring in the spaces include: *Poa costiniana* (co-dominant), *Danthonia nudiflora* (co-dominant), *Aciphylla glacialis, Asperula gunnii, Australopyron velutinum, Carex hebes, Celmisia* sp., *Craspedia* sp., *Deyeuxia crassiuscula, Empodisma minus, Epacris gunnii, Erigeron* sp., *Euchiton fordianus, Euphrasia* sp., *Luzula modesta, Microseris lanceolata, Oreobolus distichus, Prasophyllum* sp., *Stackhousia pulvinaris,* and *Wahlenbergia gloriosa.* Soils at the two sites are well developed alpine humus soils with little rock in the profile. Shining Cudweed occurs in similar herb-rich alpine grassland in Victoria.

The Seamans Hut population occurs mainly along an old track and less commonly in open tall alpine herbfield dominated by *Celmisia* sp., which is adjacent to the track.

There are several types of alpine grassland in the Kosciuszko area. Some of the grasslands dominated by *Poa costiniana*, especially near watercourses, have a thick grass cover with few inter-tussock herbs. Some, such as those observed to contain the Shining Cudweed, have large tussocks of *Poa costiniana* but large gaps between tussocks. The gaps contain the majority of species in the grassland. It is not clear how these gaps are maintained, ie. why *Poa costiniana* does not dominate to the exclusion of most other species as it does in other areas nearby? The factors responsible for gap maintenance are probably important for survival of Shining Cudweed populations at the sites observed.

The historic grazing by domestic stock is unlikely to be a factor in the current openness of grassland communities. The high country of New South Wales has not been grazed for about 40 years and there are still closed (herb-poor) and open (herb-rich) grasslands. There are also extensive areas of closed and open grasslands on the Bogong High Plains of Victoria, which are still largely grazed by cattle. Periodic infestations of case and swift moth larvae have been implicated in the death of patches of *Poa* tussocks in the high country (Williams 1987). This might explain how gaps are created but not necessarily how they are maintained. Open grasslands tend to occur higher on valley slopes whereas closed grasslands are generally found near watercourses. The higher valley slopes are drier and more exposed. They experience longer snow cover, less extremely low temperatures in summer and have less acidic soils. Higher slopes may simply be less favourable for grass growth, allowing competition from other species. Gaps in the open grassland community often have a cover of lichen and / or moss. Lichens are also abundant in some species-rich lowland grassland sites. The possible role of microphytes in the maintenance of gaps and native plant diversity has been the subject of research at La Trobe University in Melbourne (Neville Scarlett, La Trobe University, pers. comm.).

The mat-forming habit of Shining Cudweed and its apparent preference for an old walking track at one site suggest that the species is a good coloniser of bare ground in the alpine zone; indeed, that its establishment might be disturbance dependent. McDougall (in prep.) found that Shining Cudweed and another species of *Euchiton* (*Euchiton fordianus*) were amongst the most successful colonisers of a roadside batter on the Bogong High Plains in Victoria.

*Threats*

There are no obvious threats from humans to the four populations observed. Although one population occurs mainly on a walking track, the track is now seldom used and there were no signs of trampling damage to plants.

Shrubs occupy some of the gaps in the grasslands in which Shining Cudweed occurs. Invasion of inter-tussock spaces by shrubs is a consequence of cattle grazing (Williams 1987) and other disturbances. The inter-tussock shrubs observed may be an artefact of grazing in the Kosciuszko area more than 40 years ago. Alpine shrubs have been found to commonly live for more than 40 years (Williams 1987). Despite the co-occurrence of Shining Cudweed and shrubs in grassland gaps, there is no suggestion at present that shrub invasion is a threat to Shining Cudweed populations.

Infestations of larvae (presumed to be of a moth) were observed on plants at two populations in 1998. Plants of *Euchiton fordianus* were also affected, although the insect was much more common on Shining Cudweed. The larvae make silky cocoons on *Euchiton* leaves. The silky material covers a large proportion of leaves on a *Euchiton* clump. Leaf material is destroyed either by larvae eating leaves or by the prevention of photosynthesis. Up to 10% of plant clumps were

affected. Some larvae from one population have been lodged with CSIRO Division of Entomology, who will try to raise the larvae to its adult stage and identify it. Despite the large number of clumps affected by the larvae, there was no evidence, when the sites were revisited in 1999, that entire clumps had been killed. Widespread death of plants was noted in Victorian populations in early 1999 by Keith McDougall (NPWS) but considerable regeneration was also taking place.

*Previous recovery actions*

Field searches for Shining Cudweed were conducted over two days in April 1998 by Keith McDougall and Genevieve Wright (NSW NPWS) and one day in February 1999 by Keith McDougall and Colin Totterdell (CSIRO, retired). Larvae from some infested plants were collected and lodged at CSIRO Division of Entomology.

# 5 Ability of Species to Recover

The ability of the four species to recover is unknown, partly because the extent of three species is still unclear and partly because there is no evidence that the species were once more widespread. In the case of the Anemone Buttercup, there is anecdotal evidence that recovery is occurring. In the case of Feldmark Grass, the species still occupies the site where it was originally collected and the only site where it is confidently recorded from.

# 6 Management Issues

## 6.1 Trampling by Walkers

Trampling damage may have a significant impact on two of the species, the Raleigh Sedge and Feldmark Grass. The impact is difficult to assess in the case of Raleigh Sedge, the distribution of which requires further investigation.

## 6.2 Mitigation of Trampling Effects

The construction of raised walkways in feldmark areas to minimise trampling impact may have an indirect impact on the Feldmark Grass population and other feldmark species.

## 6.3 Resort Development

Whilst resort operations and development may have previously impacted on some populations of the Anemone Buttercup and expansion of summer use of resorts might have an impact within and beyond resort boundaries, it seems unlikely that these activities will have a significant impact on the species overall. With strategic planning and adequate environmental assessment under the EP&A Act of resort developments, impacts on populations of these threatened species will be minimised or eliminated.

## 6.4 Larval Damage

The threat from damage by larvae to Shining Cudweed populations is unclear but worth monitoring. If larvae are not a threat to this species, it is probably secure enough to remove from the Schedules of the TSC Act. As with many alpine species, the Shining Cudweed appears to be rare and extremely restricted but not threatened.

## 7 Recovery Objectives, Actions and Performance Criteria

The overall objective of this Recovery Plan is to gather enough information, or to have put in place measures that will enable the gathering of information, within 3 years so that the threatened status of the species can be adequately assessed and altered if appropriate.

For Anemone Buttercup and Raleigh Sedge, this will mean further survey for the quantification of population size and distribution, and evaluation of threat.

For Shining Cudweed, for which further survey is also warranted, it will be necessary to conduct monitoring of populations to assess the threat posed by moth larvae.

For the fourth species (Feldmark Grass), the distribution and population size of which is reasonably well known, the overall objective is to have set up a monitoring program within 3 years that will enable NPWS to gain an understanding of the community processes and assess the threat of bushwalkers to the single population. It is not yet clear how long it will take to obtain such an understanding, since the community processes are extremely slow.

### Specific Objective 1: Evaluation of population distribution and size

Population distribution and size for each of the species must be evaluated so that their threatened status can be assessed and nominations put to the NSW Scientific Committee to change their status, if appropriate.

*Action 1: Conduct additional searches for each of the species and submit nominations to the NSW Scientific Committee of changes to the Schedules of the TSC Act, if appropriate.*

Searches for the species will be conducted in the following manner:

**Anemone Buttercup:** A selection of the sites where the species has been recorded will be visited and population estimates made. Limited additional searches will be made in the Jagungal area (beyond the current northern limit of the species but in similar habitat) (6 days staff time).

**Feldmark Grass:** Unconfirmed locations for this species in Wrights Creek and below Seamans Hut will be checked (1 day of staff time).

**Raleigh Sedge:** The potential habitat for this species covers an enormous area (ie. bogs and mossy streamsides in the Kosciuszko and Jagungal (upper Tumut and Tooma River) areas). The survey will be targeted using maps and aerial photos and a maximum of 9 days of staff time will be allocated to the search over the period of the plan.

**Shining Cudweed:** The potential habitat for this species also covers a large area. Searches will be targeted using vegetation maps and aerial photos. The main search will be conducted in grassland near watercourses in the Kosciuszko area. Limited searches will be made in the Gungartan - Jagungal area (3 days of staff time).

*Recovery Criterion 1*

Within three years it will be possible to adequately assess the distribution of all of the species. With the data obtained from achieving the above objective it should be possible to determine if the current threatened status of the species is appropriate.

### Specific Objective 2: Quantification of the threats to Feldmark Grass and Shining Cudweed

*Action 2.1: Set up and monitor permanent quadrats along the summit walking track at Northcote Pass to assess the impact of bushwalkers on the population of Feldmark Grass.*

To assess the impact of bushwalkers on the population of Feldmark Grass, permanent quadrats will be set up along the existing walking track. Control quadrats will be set up away from the track.

This is a long-term monitoring project. Results from the monitoring may not yield information that can be used in the management of the species for a decade or more. After three seasons of data collection it should be possible to decide on a desirable frequency of monitoring and identify any major changes that occur. The majority of work and cost associated with this action will be in the first year of the Plan. Six days of NPWS staff time will be needed to set up the monitoring project and three days per year for field monitoring (this includes two days per year for data management and reporting). It may be appropriate to monitor the quadrats less frequently in the future if there is little change between years. A nominal cost might be required for publicity of the work if this is thought necessary.

An experimental section of raised walkway has been set up in another area of feldmark nearby to assess whether it can mitigate the effects of trampling by bushwalkers. Quadrats will be placed around and beneath the walkway to determine if it interferes with plant community processes. Species composition and plant numbers will be monitored in quadrats.

*Action 2.2: Set up and monitor permanent quadrats to assess the impact of larval damage on Shining Cudweed populations.*

Set up and monitor population numbers in quadrats containing Shining Cudweed to assess changes resulting from larval damage.

*Action 2.3: Conduct informal monitoring to identify other significant threats.*

Informal monitoring and observation by NPWS staff will be used to gather information on the significance of other threats (eg. picking by bushwalkers and grazing by herbivores of Anemone Buttercup, and trampling of Raleigh Sedge) before any formal monitoring is applied. Formal monitoring is not deemed necessary at this stage, as there is insufficient data to indicate that these processes will be significant threats over the period of this Plan. Most of the informal monitoring and observation will be done as part of the surveys identified in Action 1.

*Recovery Criterion 2*

The monitoring project for the quantification of threats to Feldmark Grass and Shining Cudweed is set up by the end of the first year. Management of the Feldmark Grass population is reviewed if results of the monitoring program indicate that damage is occurring through trampling. Monitoring frequency is reviewed after three years.

## 8 Social and Economic Consequences

Since the species in this plan are all within Kosciuszko National Park, there are likely to be few social and economic impacts of the recovery plan. There will be a cost in carrying out the actions identified in this plan. However, this cost is small and some of it may be absorbed by existing works and monitoring programs. Assessment of the significance of any populations of the species found in resort lease areas in the future will determine the extent of impact on development. If a development is affected there may be economic consequences for resort lessees. The social and economic consequences will be examined for each future development through the environmental impact assessment and species impact assessment processes as required by the EP & A Act and the TSC Act.

Recovery actions for one of the species (Feldmark Grass) may eventually involve minor changes to walking track alignment or surface. If adequate interpretive information accompanies any change, there may indeed be a positive social consequence resulting from a heightened awareness of rare or threatened alpine species.

## 9 Biodiversity Benefits

The protection and maintenance of populations of the four threatened plant species in this recovery plan is likely to benefit other biota, the majority of which are restricted to the high mountain region. In particular, protection of vegetation containing Feldmark Grass will protect four other rare species (*Chionohebe densifolia*, *Colobanthus pulvinatus*, *Euphrasia alsa* and *Oreomyrrhis brevipes*) and an extremely localised plant community, the feldmark. Raleigh Sedge may occur on sites containing the Southern Corroboree Frog (endangered in NSW) in the catchment of the Tumut River and possibly Tooma River. Management objectives of these two bog species are in concordance.

## 10 Implementation

Table 1 outlines the implementation of recovery actions specified in this plan for the period of three years from publication.

## 11 Preparation Details

This Recovery Plan was prepared by Keith McDougall, Senior Threatened Species Officer, and Genevieve Wright, Flora Conservation Officer, Southern Directorate (NPWS).

## 12 Review Date

This Recovery Plan will be reviewed and updated 3 years from the date of publication.

## 13 References


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**Table 1:** Estimated costs, funding source and responsible parties for implementing the actions identified in the Threatened Alpine Flora Recovery Plan.

| Action No. | Action Title | Estimated Cost/yr | | | Total Cost | Responsible party | Funding Source | In-kind | Cash |
|---|---|---|---|---|---|---|---|---|---|
| | | Year 1 | Year 2 | Year 3 | | | | | |
| 1 | Additional survey | $2,800 | $2,450 | $2,450 | $7,700 | NPWS | NPWS | $7,700 | $0 |
| 2.1 | Feldmark monitoring | $2,800 | $1,400 | $1,400 | $5,600 | NPWS | NPWS | $5,600 | $0 |
| 2.2 | Cudweed monitoring | $350 | $350 | $350 | $1,050 | NPWS | NPWS | $1,050 | $0 |
| 2.3 | Informal monitoring | $0 | $0 | **$0** | $ 0 | NPWS | NPWS | $0 | $0 |
| **Total** | | $5,950 | $4,200 | $4,200 | $14,350 | | | $14,350 | $0 |

i. Costs are approximate based on 2000 figures.
ii. The cost of all actions will be met using the staff and resources of the Southern Directorate.


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