The flora of Nungar Plain, a treeless sub-alpine frost hollow in Kosciuszko National Park

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Nungar Plain is a large, naturally treeless area in the northern part of Kosciuszko National Park. A brief survey of the flora of Nungar Plain (December 2001–January 2002) recorded 206 taxa, 18 of which were introduced. Seven taxa appear to be of especial significance. The great floral diversity of Nungar Plain suggests that the botanical significance of sub-alpine plains in Kosciuszko National Park has been under-estimated. The flora and vegetation of Nungar Plain are threatened by pigs, which have scoured large areas of grassland vegetation. In six pairs of quadrats across disturbance boundaries, damage by pigs was found to have greatly reduced the cover and diversity of vegetation. Control of pigs is urgently required.

Introduction

Whilst the composition and significance of the alpine flora of New South Wales has received considerable attention (e.g. McVean 1969, Barlow 1989, Costin et al. 2000), little has been published about the flora of sub-alpine plains in New South Wales (an exception being Benson 1994). This is in contrast to the ACT and Victoria, where the flora and vegetation of sub-alpine plains has been well studied (e.g. McDougall 1982, Walsh et al. 1984, Helman & Gilmour 1985). In addition, the vegetation of sub-alpine plains in New South Wales has not been accorded especial significance. Whilst several alpine plant communities are listed in the Kosciuszko Plan of Management's Schedule of Significant Natural Features (NPWS 2000), of the sub-alpine communities, only wetlands are listed. Benson (1994) considered the montane grassy plains of Kosciuszko National Park to be well conserved and did not identify threats to their survival and integrity.

While searching for populations of threatened plant species in the Kiandra area between 1999 and 2001, we noticed considerable damage to sub-alpine treeless vegetation by pigs. Most damage was recorded in dry grassland communities and was evidenced by denuded circles up to 20 m in diameter. Some of these bare circles appeared to have been scoured more than once, judging by the varying amount of regeneration within them. Permanent quadrats to measure degradation and regeneration are currently being set up. This paper presents some data from quadrats in one sub-alpine plain affected by pigs and includes a checklist of the flora recorded there. We re-appraise the significance of sub-alpine treeless vegetation and threats to its survival.

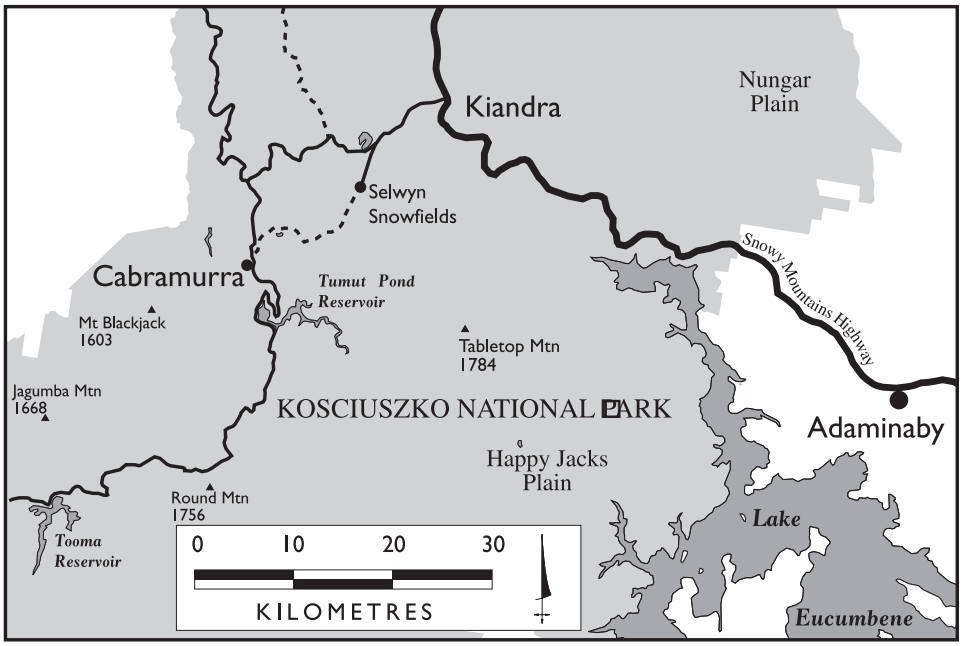

Fig. 1. Location of Nungar Plain, Kosciuszko National Park.

Fig. 2. View across Nungar Plain from a heathy knoll dominated by *Eucalyptus lacrimans*.

Methods

Nungar Plain

Nungar Plain is on the eastern edge of Kosciuszko National Park, to the south of Tantangara Dam and about 15 km east of Kiandra (Fig. 1). The treeless portion of the plain is about 7 × 2 km, ranging in elevation from 1340 to 1380 m asl. Soils are of the alpine humus type developed on a parent material of Silurian siltstone and shale of the Tantangara Formation.

The plain is surrounded by woodland dominated by *Eucalyptus pauciflora*. Structurally, the treeless portion is largely grassland, although shrubland dominated by *Hovea montana* occurs on slopes with shallow soils, and one knoll in the centre of the plain is dominated by sparse, low *Eucalyptus lacrimans* trees (Fig. 2). The grasslands are of two broad types: 1) herb-rich and dominated by *Poa petrophila*, *Poa hookeri* or *Poa phillipsiana*, occurring on dry slopes and 2) species-poor and dominated by *Poa labillardierei* and/or *Austrofestuca hookeriana*, occurring on damp flats. Wetland vegetation (dominated by *Carex gaudichaudiana*) is confined mostly to cut-off meanders in the main drainage channel of Nungar Creek, although there are very small patches of *Sphagnum* bog on some tributaries. One or more aquatic species (*Myriophyllum variifolium, Nymphoides montana, Potamogeton cheesemanii*) grow along much of the creek, the latter two species being largely confined to slow-moving sections of the watercourse.

Nungar Plain has had a long history of stock grazing. Grazing pressure may have been considerably greater at Nungar Plain than on the higher parts of Kosciuszko National Park because of its much shorter duration of snow cover. Grazing by domestic stock ceased in the 1970s.

Survey

A checklist of the flora of Nungar Plain was made in about one and a half days of random meander in December 2001 and January 2002.

Six pairs of permanently marked quadrats (2.5 × 2.5 m) were set up across the boundary of areas affected by pigs. All species within each quadrat were recorded and an estimate of their cover was made using the cover rating system of McDougall et al. (2002). The percentage cover of bare ground was also estimated.

Results and Discussion

Flora and Vegetation

The survey located 206 taxa (from 44 families), 18 taxa of which are introduced (Appendix 1). The families Poaceae and Asteraceae account for 38% of the flora of Nungar Plain.

The grassland vegetation of Nungar Plain and similar treeless plains nearby was found by Benson (1994) to be distinct from grassland communities at lower elevations in the Monaro region. The grassland vegetation is also floristically dissimilar to alpine

grassland communities described by McVean (1969), which are dominated by other species of *Poa*, and appears to be floristically distinct from sub-alpine grasslands at higher elevation in Kosciuszko National Park (eg. Happy Jacks Plain). The grassland communities of the Nungar area are likely to be localised.

Conservation Significance

Considering that the Kosciuszko alpine flora comprises about 200 species from a great diversity of habitats (Costin et al. 2000), the flora of Nungar Plain is notable. Several species are of particular conservation and/or taxonomic significance:

Bulbine glauca: This species is quite common within the grassland/herbfield communities on Nungar Plain where plants are robust, with leaf dimensions exceeding those normally given for the species (e.g. Watson 1987, Godden 1993, Conran 1994). The non-rocky habitat is also very unusual for the species. Plants of *Bulbine glauca* of similar form and habitat have not been observed by either of us in other sub-alpine treeless communities in either New South Wales or Victoria. Research into its taxonomic status is warranted.

Calotis cuneata var. *pubescens*: This mat-forming daisy is apparently restricted to Nungar Plain. The sites of collections from Victoria by Ferdinand von Mueller in 1854 and from Snowy Plain in NSW by Max Mueller in 1956 have not been relocated. The taxon is believed to be extinct in Victoria (Ross in prep.). Nineteen populations of *Calotus cuneata* var. *pubescens* were located in grassland in Nungar Plain. A brief search of nearby plains (Gulf, Long and Boggy Plains) failed to locate further populations. We regard this taxon to be specifically distinct from *Calotis cuneata* (Walsh & McDougall in press).

Calotis glandulosa: This species is listed as vulnerable in New South Wales under the *Threatened Species Conservation Act 1995* (TSC Act). It is locally common in Nungar Plain and surrounding areas in grassland and on bare ground of roadside batters.

Hovea sp. aff. *heterophylla*: This is an undescribed species of *Hovea* mentioned under *Hovea heterophylla* in a revision of eastern Australian members of the genus by Thompson (2001) and since confirmed by him as such (I. Thompson, National Herbarium of Victoria, pers. comm.). At the time of writing, Thompson knew of only one specimen from the Kiandra area. This is clearly a very localised species, the precise geographic and morphological parameters of which are still not fully known.

Prasophyllum retroflexum: This species, which was previously known as *P. morganii* (now regarded as a Victorian endemic), is listed as vulnerable in New South Wales under the TSC Act. It is a localised orchid known with certainty only from grasslands in the Tantangara – Kiandra – Yarrangobilly areas (Jones 2000) but may also occur in Victoria near the Cobberas Mountains (J. Jeanes, National Herbarium of Victoria, pers. comm.). Only one plant was found in Nungar Plain during the survey but many *Prasophyllum* plants were not in flower at the time so its abundance could not be assessed. *Prasophyllum retroflexum* was also observed on Long Plain.

Senecio sp. nov. Sect. Erechthites: An ongoing revision of the genus *Senecio* has identified this as an undescribed species collected recently only from Long and Nungar Plains (I. Thompson, National Herbarium of Victoria, pers. comm.). Pre-1950

specimens are known from other sub-alpine sites in south-eastern Australia, and perhaps paradoxically, from south-western Western Australia.

Taraxacum aristum: Although known from pre-1900 specimens from both lowland and upland areas as far north as the Walcha area and Barrington Tops, this species now appears to be confined to sub-alpine areas of south-eastern Australia (ACT, NSW, Victoria and Tasmania) south of the Bimberi Range (N. Scarlett, La Trobe University, pers. comm.). It was not listed in the *Flora of NSW* treatment of *Taraxacum* (Murray 1992). It is probably very rare in NSW, however, and may be eligible for listing as threatened under the NSW *TSC* Act, considering the disturbance to its habitat by pigs. Only a few plants were seen on Nungar Plain but the species seems to be more common on Long Plain.

The Effect of Pigs

A group of 15 pigs and piglets was observed in Nungar Plain during the survey. Damage to vegetation by pigs is obvious and extensive. Herb-rich grassland communities are the worst-affected. Rooting is localised but very thorough. Total plant cover (including plant litter) in the six quadrat pairs sampled was 35% in pig-affected vegetation compared with 99% in unaffected vegetation (Fig. 3). There were 27.3 ± 2.1 species/quadrat in unaffected vegetation and 16.8 ± 3.3 species/quadrat in pig-damaged vegetation. Nineteen species recorded in quadrats in unaffected vegetation were not recorded at all in pig-affected quadrats. Of the species that were recorded in four or more quadrats in unaffected vegetation, the frequency and/or cover of the following species was more than 75% less in pig-affected quadrats: *Asperula scoparia, Brachyscome decipiens, Carex breviculmis, Epilobium billardierianum subsp. cinereum, *Hypochaeris radicata, Luzula flaccida, Microseris* sp. aff. *lanceolata, Poa hookeri, Poa petrophila, Poa phillipsiana, Pultenaea polifolia* and *Scleranthus biflorus*. The following species occurred equally frequently in unaffected and pig-affected quadrats but all had a greater cover (by at least 50%) in pig-affected quadrats: **Acetosella vulgaris, Geranium antrorsum, Senecio pinnatifolius* subsp. *pleiocephalus* and *Tristeum spicatum*. Three species (*Drabastrum alpestre, Neopaxia australasica*, and *Stellaria multiflora*), which were rarely recorded in the quadrats, appeared to benefit from pig rooting.

Changes in species composition and a large reduction in vegetation cover following pig rooting have also been reported for sub-alpine plant communities in the ACT (Alexiou 1983). Recovery in vegetation cover was found to be slow and species composition was still markedly different more than three years after disturbance. Bloomfield and Parsonson (1977) reported that pig disturbance in the ACT was associated with areas containing *Arthropodium milleflorum* and Parsonson (1979) found that this species was commonly detected in stomach contents analysis of pigs. Although *A. milleflorum* was located in the current study, it was not especially common or widespread. Despite this, there are many species in Nungar Plain that have fleshy underground organs, including several of the significant species listed above.

* exotic species.

Fig. 3. An abrupt boundary between rooted and undisturbed vegetation at Happy Jacks Plain. Many rooted areas are remarkably circular in outline.

That Benson (1994) did not report pig damage to vegetation on Nungar Plain, where it is now exceptionally obvious, suggests that pig rooting is a recent phenomenon there, or at least that the magnitude of the problem has grown greatly in recent times. There are also no obvious patches of damaged vegetation that are in an advanced stage of recovery, suggesting either that pigs continually turn over the same ground or that the pig damage is recent. If pigs are a recent threat to the vegetation of Nungar Plain, control measures are urgently required to prevent catastrophic degradation of this significant area.

Conclusions

The flora and vegetation of Nungar Plain are of considerable conservation importance. Pigs pose a significant threat to the natural values of Nungar Plain and several other treeless sub-alpine plains in Kosciuszko National Park. Further work is proposed by NPWS to investigate the effects of pig damage and the rate of recovery. A better understanding of the vegetation and flora of sub-alpine plains in the Kosciuszko should be a by-product of such studies.

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Appendix 1. Plant Species of Nungar Plain. * indicates an exotic species

FERNS AND FERN ALLIES

ASPLENIACEAE
Asplenium flabellifolium

BLECHNACEAE
Blechnum penna-marina

CONIFERS

PODOCARPACEAE
Podocarpus lawrencei

MONOCOTYLEDONS

CYPERACEAE
Carex blakei
Carex breviculmis
Carex capillacea
Carex chlorantha
Carex gaudichaudiana
Carex hebes
Carex incomitata
Carex tereticaulis
Isolepis fluitans
Isolepis producta
Lepidosperma curtisiae
Oreobolus distichus
Schoenus calyptratus

JUNCACEAE
Juncus brevibracteus
Juncus falcatus
Luzula flaccida
Luzula modesta
Luzula novae-cambriae

LILIACEAE sens. lat.
Arthropodium milleflorum
Bulbine bulbosa
Bulbine glauca
Caesia alpina
Dianella tasmanica

ORCHIDACEAE
Diuris monticola
Prasophyllum retroflexum
Prasophyllum sphacelatum
Pterostylis cycnocephala
Thelymitra cyanea
Thelymitra megcalyptra

POACEAE
Agrostis aemula
Agrostis meionectes
Agrostis venusta
**Aira elegantissima*
**Aira praecox*
**Anthoxanthum odoratum*
Austrofestuca hookeriana
Australopyron velutinum
Austrodanthonia eriantha
Austrostipa nivicola
Austrodanthonia pilosa
Deyeuxia monticola
Dichelachne crinita
Dichelachne rara
Festuca asperula
**Holcus lanatus*
Joycea pallida
Microlaena stipoides
Poa clivicola
Poa costiniana
Poa fawcettiae
Poa hiemata
Poa hookeri
Poa labillardierei
Poa petrophila
Poa phillipsiana
**Poa pratensis*
Poa saxicola
Poa sieberiana var. *cyanophylla*
Themeda triandra
Trisetum spicatum
**Vulpia bromoides*

POTAMOGETONACEAE
Potamogeton cheesemanii

RESTIONACEAE
Baloskion australe
Empodisma minus

XANTHORRHOEACEAE
Lomandra longifolia var. *exilis*

DICOTYLEDONS

APIACEAE
Aciphylla simplicifolia
Gingidia harveyana
Hydrocotyle algida
Oreomyrrhis argentea
Oreomyrrhis ciliata
Oreomyrrhis eriopoda

ASTERACEAE
Brachyscome aculeata
Brachyscome decipiens
Brachyscome obovata
Brachyscome rigidula
Brachyscome scapigera
Brachyscome spathulata
Brachyscome tadgellii
Bracteantha subundulata
Calotis cuneata var. *pubescens*
Calotis glandulosa
Cassinia sp. aff. *uncata*

ASTERACEAE cont.
Celmisia pugioniformis
Celmisia tomentella
**Cirsium vulgare*
Cotula alpina
Craspedia coolaminica
Craspedia crocata
Craspedia jamesii
**Crepis capillaris*
Cymbonotus preissianus
Erigeron bellidioides
Euchiton argentifolius
Euchiton collinus
Euchiton fordianus
Euchiton poliochlorus
Helichrysum rutidolepis
**Hypochaeris radicata*
Leptorhynchos elongatus
Leptorhynchos squamatus
Microseris sp. aff. *lanceolata*
Olearia myrsinoides
Ozothamnus secundiflorus
Ozothamnus sp. aff. *hookeri*
Picris angustifolia subsp. *merxmuelleri*
Podolepis jaceoides
Podolepis robusta
Podolepis sp. aff. *robusta*
Rhodanthe anthemoides
Senecio gunnii
Senecio pinnatifolius var. *pleiocephalus*
Senecio sp. 1 (sensu Walsh 1999)
Senecio sp. 2 (sensu Walsh 1999)
Senecio sp. nov. Sect. Erechthites
Solenogyne gunnii
Taraxacum aristum
**Taraxacum officinale sens. lat.*
**Tragopogon dubius*

BORAGINACEAE
Myosotis australis

BRASSICACEAE
Cardamine astoniae
Cardamine papillata
Drabastrum alpestre
**Erophila verna* ssp. *verna*

CAMPANULACEAE
Pratia pedunculata
Pratia surrepens
Wahlenbergia ceracea
Wahlenbergia densifolia
Wahlenbergia multicaulis

CARYOPHYLLACEAE
**Cerastium vulgare*
Scleranthus biflorus
Scleranthus fasciculatus
Stellaria multiflora
Stellaria palustris
Stellaria pungens

CLUSIACEAE
Hypericum japonicum

CONVOLVULACEAE
Dichondra repens

DROSERACEAE
Drosera peltata subsp. *peltata*

EPACRIDACEAE
Epacris breviflora
Epacris gunnii
Epacris paludosa
Leucopogon hookeri
Leucopogon montanus

EUPHORBIACEAE
Poranthera microphylla

FABACEAE
Daviesia ulicifolia
Dillwynia prostrata
Hovea montana
Hovea sp. aff. *heterophylla*
Podolobium alpestre
Pultenaea fasciculata
Pultenaea polifolia
Pultenaea subspicata
**Trifolium arvense*
**Trifolium repens*

GERANIACEAE
Geranium antrorsum

GOODENIACEAE
Goodenia hederacea subsp. *alpestris*
Velleia montana

HALORAGACEAE
Gonocarpus micranthus
Gonocarpus montanus
Myriophyllum pedunculatum
Myriophyllum variifolium

LAMIACEAE
Ajuga australis

LINACEAE
Linum marginale

MENYANTHACEAE
Nymphoides montana

MYRTACEAE
Baeckea gunniana
Eucalyptus lacrimans
Eucalyptus pauciflora
Eucalyptus rubida
Kunzea muelleri
Leptospermum myrtifolium

ONAGRACEAE
Epilobium billardierianum subsp. *cinereum*
Epilobium gunnianum

OXALIDACEAE
Oxalis exilis

PITTOSPORACEAE
Rhytidosporum alpinum

PLANTAGINACEAE
Plantago alpestris
Plantago antarctica
Plantago euryphylla

POLYGALACEAE
Comesperma retusa

POLYGONACEAE
**Acetosella vulgaris*

PORTULACACEAE
Neopaxia australasica

PROTEACEAE
Grevillea australis
Hakea microcarpa

RANUNCULACEAE
Ranunculus collinus
Ranunculus graniticola
Ranunculus lappaceus
Ranunculus millanii
Ranunculus pimpinellifolius

ROSACEAE
Acaena echinata
Acaena novae-zelandiae
**Aphanes microcarpa*
Geum urbanum
Rubus parvifolius

RUBIACEAE
Asperula gunnii
Asperula scoparia
Coprosma nivalis
Galium gaudichaudii

SCROPHULARIACEAE
Derwentia perfoliata
Euphrasia collina subsp. *paludosa*
**Verbascum thapsus*
Veronica gracilis

STYLIDIACEAE
Stylidium montanum

THYMELAEACEAE
Pimelea biflora
Pimelea linifolia subsp. *caesia*

VIOLACEAE
Hymenanthera dentata
Viola betonicifolia
Viola fuscoviolacea