THE DISTRIBUTION, ECOLOGY AND MANAGEMENT OF TWO RARE TASMANIAN SEDGES — *SCHOENUS ABSCONDITUS* KUK. AND *CAREX TASMANICA* KUK.

by Louise Gilfedder and J.B. Kirkpatrick

(with five tables and two text-figures)

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The sedges, *Carex tasmanica* and *Schoenus absconditus,* were considered to be threatened species at the national level. They are species of grassland and grassy woodland in the driest parts of Tasmania, *C. tasmanica* being associated with drainage lines, and *S. absconditus* characteristically occurring in *Themeda triandra* grassland, in situations where there is a large amount of intertussock space. Both species proved much more common than previously thought, and both species have been downlisted. They are both well-adapted to mechanical disturbance and sheep grazing. *C. tasmanica* is also herbicide resistant. However, mowing and cattle grazing deleteriously affect *C. tasmanica*. *S. absconditus* can no longer be regarded as a rare or threatened species. However, *C. tasmanica* has disappeared from two localities out of 30 in the past four years and has no substantial populations in any secure reserve. Secure reservation is needed for this vulnerable species.

Key Words: ***Carex tasmanica*, conservation, disturbance, grazing, management, *Schoenus absconditus*.**

INTRODUCTION

The maintenance of native biological diversity is now a major national policy goal in Australia. If the species level of native biological diversity is to be maintained, rare and threatened taxa need particular attention, as these are most likely to become extinct in the near future. National listings of rare and threatened vascular plant species have been available for Australia for some time (e.g. Briggs & Leigh 1988). These have been based on information on current distributions and population sizes that is often very partial, especially in the cases of sedges (Cyperaceae), rushes (Juncaceae) and grasses (Poaceae), which tend not to be favoured by collectors and which often present identification difficulties. There is a need to gain data on the distribution and ecology of listed species, in order to confirm or reject their listed status and to develop, if necessary, programs for their recovery. In this paper we report such investigations into the distribution, ecology and management of two Tasmanian sedges, *Carex tasmanica* and *Schoenus absconditus.*

Carex tasmanica is a tufted rhizomatous perennial sedge with distinctive coiling of the distal portion of the etect leaves (Curtis & Morris 1994). The leaves may be flat, broad or inrolled, and may be up to 0.4 m long. *S. absconditus* is also a tufted thizomatous perennial sedge which is distinguished by a very short culm bearing the inflorescence (Curtis & Morris 1994).

Schoenus absconditus was recorded on the national listing as a vulnerable Tasmanian endemic species with a distribution of less than 100 km^2 (Briggs & Leigh 1988). *C. tasmanica* was originally more widespread in its distribution, occurring in eastern Tasmania and in western Victoria, where it is now considered a vulnerable species (Gullan *et al.* 1990). It is also reported as occurring on the Darling Downs of Queensland (Hnatiuk 1990) — although there are no records at the Queensland Herbarium (R. Fensham, pers. comm.). The species has been listed as nationally endangered (Briggs & Leigh 1988) but was not included in the recent national list (Endangered Flora Network 1993), nor listed at the state level by the Flora Advisory Committee (1994).

METHODS

The former and extant distributions of *Carex tasmanica* and *Schoenus absconditus* were determined from herbarium collections, literature references and survey data. Searches were made at these sites and environmentally similar ones. Where either species was located, floristic and site data were recorded. Quadrats measuring 1 x 10 m were subjectively placed in the least disturbed vegetation in which *C. tasmanica* or *S. absconditus* occurred. Presences were recorded for all vascular plant species. Species nomenclature follows Buchanan (1995).

Altitude, surface geology, soil type and surface soil pH (using a CSIRO soil-testing kit) were measured or noted in the field. The slope and aspect of each site were determined, using a clinometer and compass respectively. Climatic data were derived for each site using the Bioclimatic Prediction System (Busby 1988).

The polythetic divisive technique TWINSPAN (two-way indicator species analysis) (Hill 1979) was used to obtain sorted tables for quadrats with each species. These were re-sorted manually and used as the basis for the selection of communities.

The percentage frequencies of species in the quadrats with *S. absconditus* and those with *C. tasmanica* were calculated, as were the percentage frequencies of all species in a grassland and grassy woodland database, consisting of 1206 quadrats. A list was made of those species that occurred in 10% or more of quadrats in any of the databases, the list being separated into those occurring more frequently with *S. absconditus*, those occurring more frequently without *S. absconditus*, those occurring more frequently with *C. tasmanica* and those occurring more frequently without *C. tasmanica*. These species were then classified into lifeform

groups (shrub or tree; grass or graminoid; herb; geophyte) and two origin groups (Tasmanian native; other).

The response of *S. absconditus* to different management regimes was documented by placing transect lines through vegetation under different management containing the species and determining their density. *S. absconditus* plots were established in ungrazed, lightly grazed, heavily grazed situations, and on revegetating gravel pits. The former two situations were at Tunbridge, while the latter two were at Nile. For *C. tasmanica* transects were placed in vegetation at the Queens Domain that was either regularly mown, burned then sprayed with a broadleaf selective herbicide or mulched with woodchips. These transects were monitored from 1991–95 to determine the effect of site management on numbers of *C. tasmanica*. Kruskal-Wallis One-way Analysis of Variance by Ranks and the Mann-Whitney U Test (Siegel 1956) were used to determine if the densities of *S. absconditus* and *C. tasmanica* significantly varied under different management regimes, over time, and in relation to various ground covers.

RESULTS AND DISCUSSION

Distribution, Environment and Phytosociology of *Carex tasmanica*

Carex tasmanica was recorded at 27 locations in northern, eastern and southern Tasmania, and the Midlands (fig. 1). It occurs from sea level to approximately 600 m on a wide range of soil types derived from dolerite, basalt, sandstone and wind-blown sands. The pH of these soils varies from weakly acid to weakly alkaline, with a median value of 7.0. Mean annual precipitation varies from approximately 550 mm to approximately 700 mm, with a median value of 656 mm. Mean precipitation in the driest monrh varies from approximately 35 mm to 75 mm with a median of 65 mm. The mean temperature of the warmest month varies from 12.3° to 16.3°C with a median value of 15.5°C, and that of the coldest from 4.5° to 8.6°C with a median of 7.0°C.

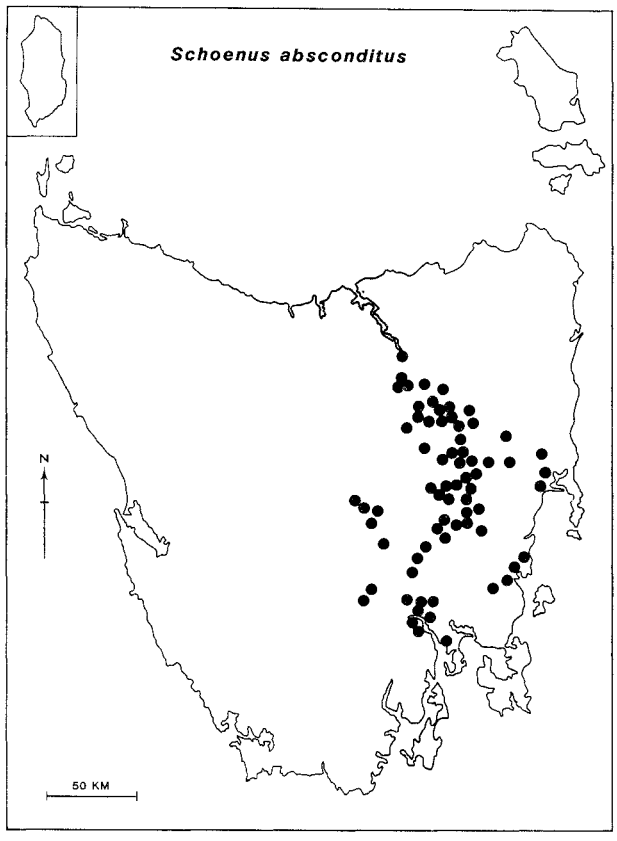

FIG. 1 — Distribution of Schoenus absconditus.

All of the populations are associated with constantly moist places, such as seepage or drainage lines. Tree cover is rare, but the species does occur in woodland and forest communities dominated by *Eucalyptus ovata*. Most of the populations occur in a matrix dominated by exotic species. The percentage of exotic species in quadrats varied from 25 to 90 with a mean of 51. *Carex gunniana*, *Juncus* spp., native *Poa* spp. and *Acaena novae-zelandiae* were the only native taxa to occur in more than 40% of the quadrats with *C. tasmanica*. The exotic species found in more than 40% of the quadrats were *Holcus lanatus*, *Plantago lanceolata*, *Hypochoeris radicata*, *Leontodon taraxacoides* and *Agrostis capillaris*.

The native species that were more abundant with *C. tasmanica* than in the grasslands and grassy woodlands database as a whole were mostly taxa characteristic of the margins of wetlands, including *Leptospermum lanigerum*, *Poa labillardierei*, *Carex gunniana*, *Eleocharis acuta*, *Juncus australis* and *J. pauciflorus*. Thirty of the 43 species that were more abundant with *C. tasmanica* than in the larger dataset were exotics, mostly herbs and perennial grasses (table 1). In contrast, only five of the 73 species that were more abundant in the larger dataset were exotics (table 1).

The high and variable degree of invasion by exotics makes it difficult to perceive strong communities within the sorted table (table 2). However, the left half of the matrix can be distinguished from the right half on the basis of the relatively high constancy and fidelity of the native species: *Asperula conferta*, *Geranium solanderi*, *Veronica gracilis*, *Poa labillardierei* and *Acaena novae-zelandiae*. The right half of the matrix is less strongly distinguished by the relatively high constancy and fidelity of the native species: *Carex gunniana*, *Themeda triandra*, *Hypericum gramineum* and *Juncus pauciflorus*. The former community tends to be associated with sedimentary rocks and streamsides in the inland locations, while the latter tends to occur preferentially on igneous rocks and soaks near the coast.

Distribution, Environment and Phytosociology of *Schoenus absconditus*

Schoenus absconditus was found at more than 70 localities (fig. 2). It has been previously misidentified as the more common *S. apogon*. It occurs in southeastern and eastern Tasmania, being recorded as far north as Launceston. It occurs on soils ranging in texture from sandy loams to clay loams and clays derived from basalt, dolerite, sandstone, mudstone, alluvium and Holocene deposits. These soils vary in surface pH from 6.0 to 9.0 with a median value of 6.5. It ranges in altitude from sea level to 650 m. Mean annual rainfall varies from 450 to 900 mm with a median of 605 mm, with the rainfall in the driest month varying from 20 mm to over 70 mm with a median of 60 mm. The mean temperature of the warmest month varies from 12.6° to 16.3°C with a median of 15.6°C, and that of the coolest month varies from 4.6° to 8.5°C with a median of 6.5°C.

TABLE 1
Composition of lifeform groups associated with *Carex tasmanica* or *Schoenus absconditus**

Lifeform group	More common with *Carex*		Less common with *Carex*	
	Observed	Expected	Observed	Expected
Trees and Shrubs	5	6	10	9
Grasses and graminoids	15	16	28	29
Herbs	23	20	31	34
Geophytes	0	1	4	3
Total	43	43	73	73
Lifeform group	More common with *Schoenus*		Less common with *Schoenus*	
	Observed	Expected	Observed	Expected
Trees and Shrubs	2	6	9	5
Grasses and graminoids	14	19	23	18
Herbs	37	30	22	29
Geophytes	5	3	1	3
Total	58	58	55	55

* The number of species in different lifeform groups that are more frequent in vegetation with either *Carex tasmanica* or *Schoenus absconditus* than in Tasmanian grasslands and grassy woodlands and vice-versa. Only species occurring in more than 20% of the quadrats in at least one of the data sets are included.

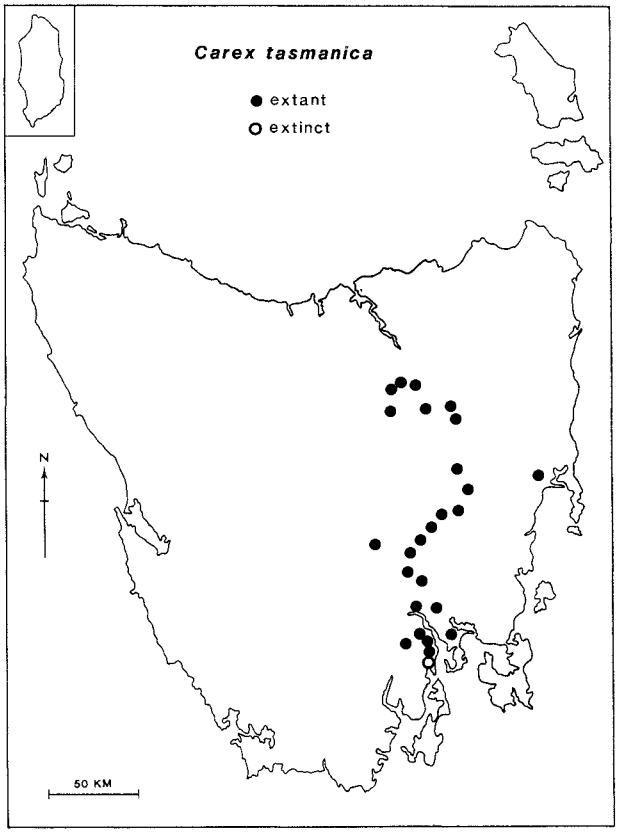

FIG. 2 — Distribution of Carex tasmanica.

Schoenus absconditus occurs in grasslands and grassy woodlands on well-drained sites in which the ground stratum is dominated by kangaroo grass (*Themeda triandra*), wallaby grass (*Danthonia* spp.), tussock grass (*Poa* spp.) and a rich variety of herbs. *Eucalyptus pauciflora* and *E. ovata* are the most common dominants in woodland with *S. absconditus*. Native species tend to dominate the cover and richness of the quadrats. The percentage of exotic species in quadrats varied from zero to 60, with a mean of 22.

The native taxa that occurred in more than 40% of the quadrats with *S. absconditus* were *Themeda triandra*, *Danthonia* spp., native *Poa* spp., *Leptorhynchos squamatus*, *Oxalis perennans*, *Carex breviculmis*, *Geranium solanderi*, *Plantago varia*, *Ehrharta stipoides* and *Pimelea humilis*. Only three exotics were as frequent. These were *Aira caryophyllea*, *Centaurium erythraea* and *Leontodon taraxacoides*. The native species that occurred in more than 10% of the quadrats with *S. absconditus* and had a higher percentage frequency in these than in the grasslands and grassy woodlands data set were mainly perennial herbs. More herbs and geophytes than expected occurred preferentially with *S. absconditus* (table 1). The converse was true for grasses and graminoids, and for shrubs and trees. Eighteen of the 58 species that occurred preferentially with *S. absconditus* were exotics, largely grasses and herbs. Of those 55 species that occurred preferentially in the data set as a whole, only four were exotics.

The sorted table (table 3) is again somewhat diffuse. However, the quadrats divide into two approximately equal sets, one of which is characterised by the following native plants: *Chrysocephalum apiculatum*, *Geranium solanderi*, *Danthonia tenuior*, *Vittadinia muelleri*, *Scleranthus diander*, *Convolvulus erubescens*, *Ptilotus spathulatus* and *Pimelea humilis*. The other is characterised by the following native species: *Gnaphalium collinum*, *Hypericum gramineum*, *Ehrharta stipoides* and *Drosera peltata*.

TABLE 2

Sorted table for quadrats with *Carex tasmanica*

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                          1223112112 123433333    1 23 1 12331222
                          5145275036569004678979469302142831312788

Lomandra longifolia       111--------------11-------------1-------
*Acetosella vulgaris      11----------1---1-1-----------------1---
*Aphanes arvensis         -1-----------------1--------------------
*Trifolium pratense       -11-----------1----1--------------------
*Poa pratensis            1-1---------------1-1-------------------
Hypoxis glabella          -11--1-----------------------------------
*Bromus mollis            111--------------------------------------
*Briza minor              -1--1------------------------------------
Mazus pumilio             --1--1-----------------------------------
*Bromus diandrus          11-1-------1-----------------------------
*Rumex crispus            1------------11--1-1---------------------
*Phalaris spp.            -------------1----1----------------------
*Carduus nutans           ------------1---1------------------------
Ehrharta stipoides        -1--1-------1----------------------------
*Lolium perenne           1-11-11-11-1--1--11----------------------
Elymus scabrus            ----1-----11-----------------------------
Carex gaudichaudiana      -----1----11-----------------------------
*Trifolium glomeratum     ----1----1-1-----------------------------
Juncus bufonius           ----1-----1------------------------------
+Schoenus absconditus     -----1-1-111-----------------------------
Asperula conferta         -------1-111----1--1---------------------
Geranium solanderi        -------111-1---11-11---------------------
*Myosotis discolor        ----------1-------1----------------------
Veronica gracilis         -----1-111-1---11-----------------------1
*Cirsium vulgare          1-11--111111-1-111--1-------1------------
*Bellis perennis          ----------11-------1-------1------------
*Trifolium dubium         -1---1-111-111-----1-----------1-1-1---
*Taraxacum officinale     -----111-1-------------------------------1-
Poa labillardierei        111-11-11111---111-1-111111--1--1-------
*Aira caryophyllea        -1--11-----------------------------------1
Acaena novae-zelandiae    11--1--1111111-1111---1-----1---1-------
*Prunella vulgaris        ----1-------1--------------------1------
Juncus australis          ----1-------11-11--------------------11-
*Plantago coronopus       -1-111-1-1111-1-----11-----------11-1--
Epilobium billardierianum -------1-1----------1------------------
Carex breviculmis         -1-----1-11-------------------------1-1-1
Calocephalus lacteus      ---------1-------------------------------1--
Juncus subsecundus        --------1---------------------------------1
*Trifolium repens         --------1-1---------1-----------1------
Acaena agnipila           ----------1----------1------------------
Leptorynchos squamatus    -1--------1-----------------------------1
Oxalis perennans          -1--1--1-----------1------1-------------
*Hypochoeris radicata     -111--11-1--11-1111111111--11-----1-1--1
Eryngium vesiculosum      --1---------------------------------------1
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                          1223112112 123433333    1 23 1 12331222
                          5145275036569004678979469302142831312788

Oreomyrrhis eriopoda      ----------------1--------------------1
*Anthoxanthum odoratum    1----1--------------1--1---------------
Danthonia carphoides      -1-------------------------1-----------
*Trifolium subterraneum   -1---------------------------------1---
*Vicia sativa             1-------------1-------11--------------
*Cirsium arvense          -------------------1----------1--------
*Cynosurus cristatus      ----1-------------------------------1------
Carex tasmanica           11111111111111111111111111111111111111111
Juncus spp.               1-111--1111111111----1111111-1111-1-1111
*Holcus lanatus           1-1-11-111111--1111-11111111111111-11111
*Plantago lanceolata      1---1111--1111-11-1-111111111-1111111111
Danthonia spp.            -1--11----1-1-------1--1111-11---------1
Acaena echinata           ----------11-----1-11-----------1----1
*Leontodon taraxacoides   --1-1--1-111111-----11111---11--111----1
Eleocharis acuta          -----1--------11-------1-----111--------
Leptospermum lanigerum    ---------1----------------------1--1-1--
Hypericum gramineum       --------1------------------------111-1--
Carex gunniana            -------111-11------11-111-1----111-1-1--
*Rosa rubiginosa          ----1--------1---1----1-------11-1-111--
*Potentilla spp.          -------------1--------------1----1------
*Sonchus asper            ----------------1--1--------11-----1111-
*Anagallis arvensis       ------------1----------11-------11------
*Ulex europaeus           ---1-1----------------111-------1--1-1--
*Dactylis glomerata       -------------1---11-1111------1--1--11--
*Agrostis capillaris      ----1---1-11--11-1--11111-------1111111-
Themeda triandra          -11------------------1-11111------1----1
Schoenus apogon           --1-11--1-----------1-11111-1-----1-----
*Centaurium erythraea     ----1---------------1-1-----------------
*Tragopogon porrifolius   1--1-----------------1--------11--------
*Picris hieracioides      -------------1------1--1----1-1---------
Plantago varia            ------1----------------------1----------1
Danthonia caespitosa      ----------1--------------11-------------
Danthonia laevis          ----1---------------1-----------------1
*Juncus articulatus       ---1------1---1--------11-1---11-------1
*Dipsacus fullonum        --------------------------11-----1-11-1--
Dichondra repens          ------------------------------1------1
*Rubus fruticosus         -------------------------111111----1-1-1--
Poranthera microphylla    -------------------------11-------------
*Urospermum dalechampii   ----------------------------11--------
*Avena fatua              -------------------------11-1-----------
*Crataegus monogyna       -------------------------11-1-----1-----
Juncus pauciflorus        1-----------------------11--111--------
Eleocharis sphacelata     ----------------------------1-----------
*Foeniculum vulgare       -------------------------11-1-11--------
Ajuga australis           ---------------------1-1----------------
Danthonia racemosa        ----------------------11---------------
*Sonchus oleraceus        ----------------------11---------------
*Lolium rigidum           ----------------------11---------------
Agrostis avenacea         ----------------------11--------------1
*Lotus corniculatus       ---------------------1-----------------1
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Additional species
15: **Cerastium glomeratum, *Phalaris canariensis*
21: *Colobanthus curtiseae, Crassula sieberiana, Chrysocephalum apiculatum, *Erophila verna, Hovea linearis, *Parentucellia viscosa, Pimelea humilis, Scleranthus biflorus*
24: *Bolboschoenus caldwellii, Cotula australis, Glyceria australis, Hypoxis hygrometrica, Ranunculus decurvus, Senecio hispidulus, Villarsia reniformis*
35: **Erodium cicutarium, *Lepidium africa hnum, *Poa bulbosa*
12: *Rumex dumosus, Solenogyne gunnii*
17: *Acaena ovina, Danthonia semiannularis, Drosera peltata, Plantago antarctica*
25: **Briza maxima, *Eragrostis sp., *Trifolium fragiferum*

*** = introduced species**
+ = endemic species

13: *Carex appressa, Carex inversa*
26: *Drosera pygmaea*
16: **Plantago major*
29: *Dichelachne rara, Hydrocotyle sibthorpioides*
30: *Epilobium hirtigerum*
40: **Lysimachia nummularia*
34: **Potentilla spp., *Rumex pulcher*
36: **Capsella bursa-pastoris, Plantago paradoxa*
37: **Cynosurus echinatus*
38: **Achillea spp., Hemarthria uncinata*
39: **Moenchia erecta, *Ranunculus repens*
7: **Linum trigynum*
9: *Astroloma humifusum, Eucalyptus ovata, Geranium potentilloides, Juncus planifolius, Linum marginale*
4: **Erica lusitanica, Eriochilus cucullatus, Eucalyptus globulus, Leptospermum scoparium, *Leucanthemum vulgare*
6: *Stipa spp.*
19: *Baumea acuta, Isolepis platycarpus*
14: *Danthon gia penicillata*
23: **Salix alba, Gonocarpus tetragynus*
22: *Rumex brownii*
28: **Juncus capitatus, *Paspalum dilatatum*
8: *Carex iynx, Centipeda minima, Cotula reptans, Geranium sessiliflorum, Hypericum japonicum, Plantago daltoni*

The latter community occurs in areas of higher available moisture than the former, which is the characteristic community of the driest sites on nutrient-rich soils in the state.

Responses of the Species to Different Management Regimes

Both species can respond favourably to mechanical disturbance. Many of the *C. tasmanica* populations grow in drainage ditches, and young plants are usually associated with bare ground. *S. absconditus* attained its highest measured density on an old lateritic gravel pit (mean = 305 per m^2, standard error = 32). *S. absconditus* is also tolerant of mowing and the scraping of the topsoil (A. North, pers. comm.).

Neither species appeared to be disadvantaged by sheep grazing, although *C. tasmanica* does not respond well to cattle grazing, being absent across fencelines where cattle are grazed. The relative densities per m^2 of *S. absconditus* in ungrazed (mean = 124, standard error = 24), lightly grazed (mean = 169, standard error = 23) and heavily grazed (mean = 188, standard error = 39) native pastures indicate that this species may be favoured by grazing, presumably as a result of competition reduction (cf. Gilfedder & Kirkpatrick 1994). The density of *S. absconditus* varies significantly with either grass cover, being highest at medium levels; bare ground, being highest at medium levels and absent where bare ground is absent; rock cover, being greatest at high and low levels; or litter, being highest at low levels (table 4).

Carex tasmanica also occurs at sites where herbicide has been used to control roadside vegetation. Where most species have died, it maintains its health.

Pine bark mulching was the most successful of the treatments for the establishment of new germinates (table 5). Mowing appeared to preclude such establishment (table 5). The three treatments resulted in no statistically significant changes in percentage cover, number of clumps or number of individuals over the four-year period. There was an unsurprising significant increase in grass, exotic herb and exotic rosette cover in the four years after the burning and herbiciding treatment, but the levels of cover were not as great as those resulting from the mowing treatment. Exotic grass cover also significantly increased over the four years in the woodchip mulch and mown treatments (table 5).

Conservation and Management

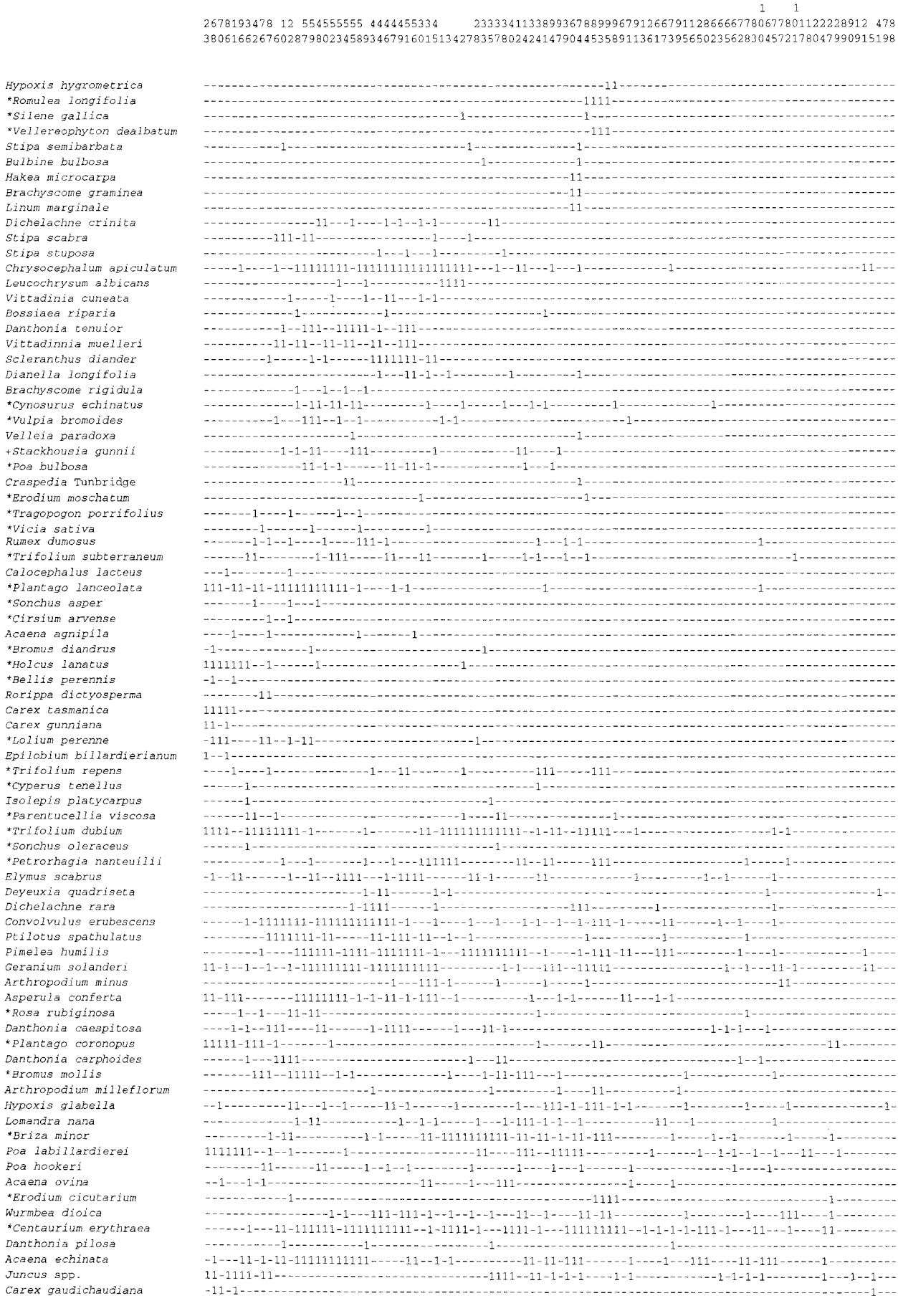
We located many previously unknown populations of both *C. tasmanica* and *S. absconditus* between 1991 and 1995. *S. absconditus* proved to be extremely common in native pastures. It is found in two secure reserves (Township Lagoon Nature Reserve and Tom Gibson Nature Reserve), and in several less secure reserves, such as the Meehan Range State Recreation Area and the Queens Domain in Hobart. This security, its large number of known populations and its ability to persist with current land use, short of cultivation, has resulted in its removal from the national listing of threatened species (Endangered Flora Network 1993) and the Tasmanian state listing (Flora Advisory Committee 1994).

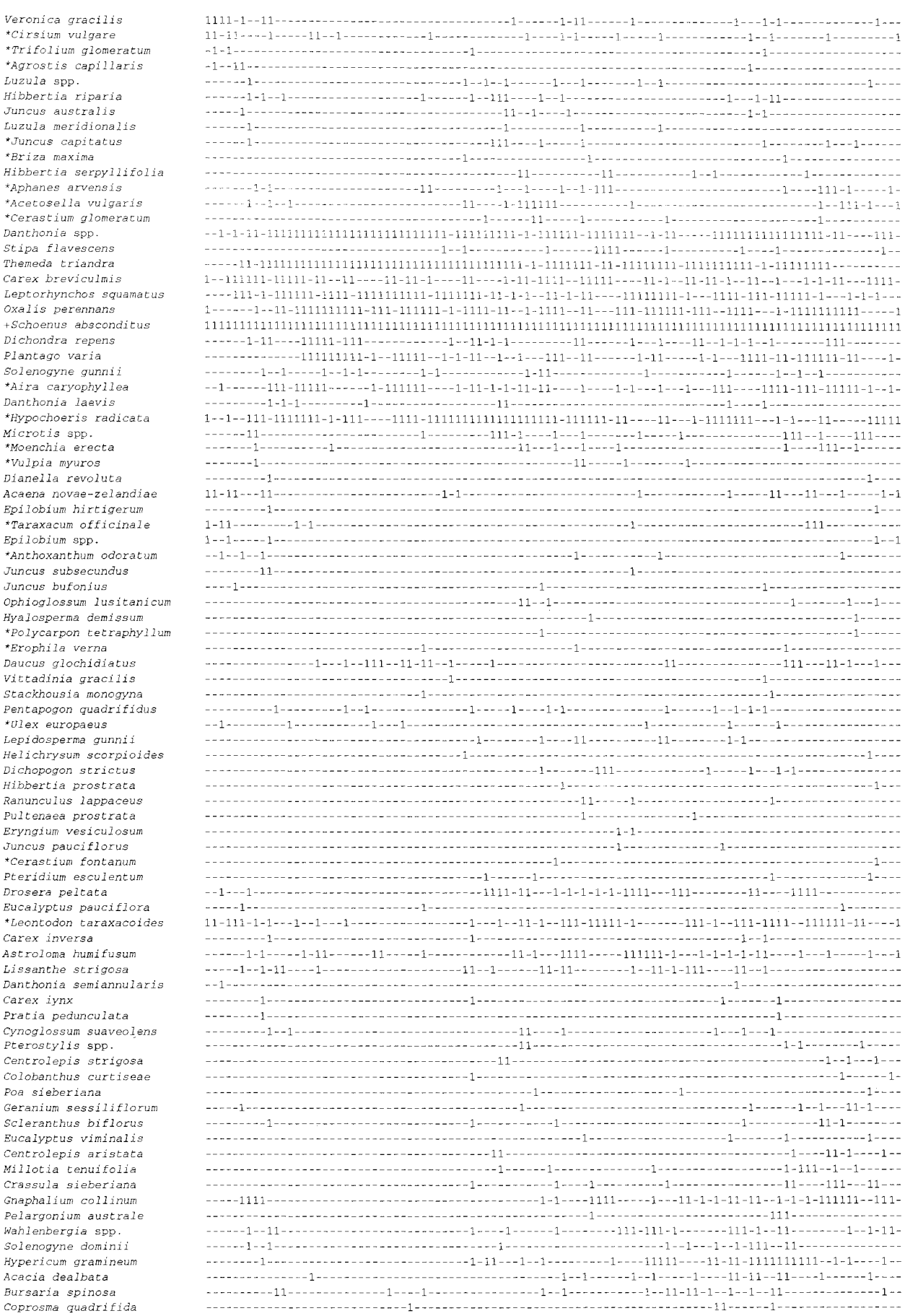
The majority of the populations of *C. tasmanica* are on either private land or on road or rail reserves. It occurs in a number of council reserves, such as the Queens Domain in Hobart. Two individuals were recorded from a picnic area at Myrtle Gully within the Mount Wellington Park, which has secure status. Another slightly larger population occurs within the less secure Lake Dulverton Wildlife Sanctuary.

Although many new populations of *C. tasmanica* have been found, its future is not considered secure. Virtually all populations are found on private land or roadside verges,

TABLE 3

Sorted table for quadrats with *Schoenus absconditus*




Veronica gracilis
**Cirsium vulgare*
**Trifolium glomeratum*
**Agrostis capillaris*
Luzula spp.
Hibbertia riparia
Juncus australis
Luzula meridionalis
**Juncus capitatus*
**Briza maxima*
Hibbertia serpyllifolia
**Aphanes arvensis*
**Acetosella vulgaris*
**Cerastium glomeratum*
Danthonia spp.
Stipa flavescens
Themeda triandra
Carex breviculmis
Leptorhynchos squamatus
Oxalis perennans
+*Schoenus absconditus*
Dichondra repens
Plantago varia
Solenogyne gunnii
**Aira caryophyllea*
Danthonia laevis
**Hypochoeris radicata*
Microtis spp.
**Moenchia erecta*
**Vulpia myuros*
Dianella revoluta
Acaena novae-zelandiae
Epilobium hirtigerum
**Taraxacum officinale*
Epilobium spp.
**Anthoxanthum odoratum*
Juncus subsecundus
Juncus bufonius
Ophioglossum lusitanicum
Hyalosperma demissum
**Polycarpon tetraphyllum*
**Erophila verna*
Daucus glochidiatus
Vittadinia gracilis
Stackhousia monogyna
Pentapogon quadrifidus
**Ulex europaeus*
Lepidosperma gunnii
Helichrysum scorpioides
Dichopogon strictus
Hibbertia prostrata
Ranunculus lappaceus
Pultenaea prostrata
Eryngium vesiculosum
Juncus pauciflorus
**Cerastium fontanum*
Pteridium esculentum
Drosera peltata
Eucalyptus pauciflora
**Leontodon taraxacoides*
Carex inversa
Astroloma humifusum
Lissanthe strigosa
Danthonia semiannularis
Carex iynx
Pratia pedunculata
Cynoglossum suaveolens
Pterostylis spp.
Centrolepis strigosa
Colobanthus curtiseae
Poa sieberiana
Geranium sessiliflorum
Scleranthus biflorus
Eucalyptus viminalis
Centrolepis aristata
Millotia tenuifolia
Crassula sieberiana
Gnaphalium collinum
Pelargonium australe
Wahlenbergia spp.
Solenogyne dominii
Hypericum gramineum
Acacia dealbata
Bursaria spinosa
Coprosma quadrifida
Poa rodwayi
Ehrharta stipoides
Lomandra longifolia
Thelymitra spp.

Additional species

68: **Plantago major* 70: *Eleocharis acuta, Mazus pumilio, Plantago antarctica* 86: *Drosera pygmaea, Leptospermum lanigerum* 11: **Juncus articulatus* 196: **Dactylis glomerata* 42: *Senecio quadridentatus* 76: *Calochilus herbaceus, Villarsia reniformis* 87: **Trifolium pratense*10: *Ranunculus scapigerus* 22: **Rumex crispus* 59: **Cardaria draba, *Poa pratensis* 48: *Daviesia ulicifolia* 52: *Trachymene humilis* 49: **Crataegus monogyna* 30: **Conyza albida, Isoetopsis graminifolia, *Passiflora cinnabarina* 45: *Chrysocephalum semipapposum* 7: *Stipa mollis* 28: **Bromus hordeaceus* 33: *Bulbine glauca, Luzula flaccida* 40: *Bossiaea cinerea* 12: *Pterostylis cynocephala* 14: **Arctotheca calendula, Pterostylis cucullata* 34: *Comesperma volubile, Senecio glomeratus* 60: *Banksia marginata, Chrysocephalum aff.apiculatum* 74: *Microtis unifolia, Stipa pubinodis* 84: *Rubus parvifolius* 85: *Wurmbea uniflora* 98: *Imperata cylindrica* 71: *Burchardia umbellata, Juncus procerus, Tetratheca procumbens* 91: *Cotula reptans, *Erodium botrys* 13: *+Epacris tasmanica, +Eucalyptus pulchella, Leptospermum scoparium* 26: *+Bedfordia salicina, +Cyathodes pendulosa, Notelaea ligustrina* 61: *Lythrum hyssopifolium* 67: *Danthonia racemosa* 16: *Epacris gunnii, Grevillea australis, Melaleuca gibbosa, Pomaderris pilifera, +Spyridium microphyllum, Styphelia adscendens* 80: *Pultenaea pedunculata* 62: **Linum trigynum* 65: *Eriochilus cucullatus* 66: *Juncus filicaulis* 72: *+Clematis gentianoides* 83: *+Melaleuca pustulata* 100: *Danthonia setacea, *Reseda luteola* 64: *Agrostis aemula, Asplenium flabellifolium, Epacris impressa* 75: **Cynosurus cristatus* 82: *Diuris sulphurea, Hydrocotyle callicarpa* 101: *+Ozothamnus scutellifolius* 20: *Cryptandra amara, Stylidium graminifolium* 27: *Ozothamnus ferrugineus* 89: *Aphelia pumilio, Calandrinia calyptrata, *Cicendia filiformis, *Sagina apetala* 21: *Amperea xiphoclada, +Eucalyptus tenuiramis, Hovea linearis* 5: *Acianthus* spp., *Brachyloma ciliatum, Cotula australis, Gonocarpus micranthus, Hydrocotyle hirta, *Sagina procumbens* 41: *Ehrharta distichophylla, Eucalyptus globulus, Olearia phlogopappa, Olearia ramulosa, Pomaderris elliptica* 79: *Agrostis parviflora, Baeckea gunniana, Cotula alpina, *Verbascum thapsus, Viola cleistogamoides* 88: *Hymenanthera dentata*

* = introduced species, + = Tasmanian endemic species

TABLE 4
Mean densities of *Schoenus absconditus** in varying cover classes

Type of cover	Cover class†							H‡
	0	1	2	3	4	5	6	
grass	–	332	170	182	92	–	185	12.14 §
herb	–	–	287	152	215	–	–	7.88
exotics	83	196	195	220	–	–	–	4.91
bare ground	–	159	220	262	238	184	95	21.19 ¶
rock	163	84	–	–	–	395	237	21.44 ¶
litter	193	141	313	262	–	123	–	11.50 §

* Mean densities per square metre (Mueller-Dombois & Ellenberg 1974)
† 0 = 0%, 1 = 1%, 2 = 2–5%, 3 = 6–25%, 4 = 26–50%, 5 = 51–75%, 6 = 76–100%
‡ H values and significance levels for the Kruskal-Wallis One-Way Analysis of Variance by Ranks (§ = P<0.05, ¶ = P<0.001)

and generally consist of less than 100 individuals, making them highly vulnerable to localised extinction through the inadvertent or deliberate use of a plough or grader. Such an extinction occurred in the municipality of Kingborough in the course of road preparation for a subdivision. During the last five years, two populations have become extinct. This is a loss of more than 10% of the known populations every decade — a rate which could lead to the endangerment or extinction of the species within 50 years. The species is best considered to be vulnerable to extinction and should be reinstated to the state list of threatened flora (Flora Advisory Committee 1994).

Carex tasmanica does not place high demands on managers (Gilfedder 1991). The avoidance of deep scraping, cattle grazing and mowing, and the maintenance of the other forms of disturbance currently employed are all that is required. It would be highly desirable to ensure that at least one large population was within a secure reserve. Areas that might be suitable for secure reservation include city parks and some private land. There are areas of private grassland with this species that, if purchased and maintained under present management regimes, would also increase the security of lowland temperate grassland and other rare and threatened species (Kirkpatrick 1994).

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TABLE 5
Mean and standard error of *Carex tasmanica* and other lifeform groups under different management regimes*

	1991†	1995†
***Carex tasmanica* individuals/m²**		
woodchips	137.6 ± 37.8	156.3 ± 39.2
spray/burn	96.9 ± 33.9	350.0 ± 110.0
mown	92.5 ± 28.1	147.5 ± 41.7
***Carex tasmanica* clumps/m²**		
woodchips	8.73 ± 1.91	16.85 ± 2.96
spray/burn	10.27 ± 3.56	9.82 ± 2.83
mown	19.38 ± 4.61	18.13 ± 4.61
***Carex tasmanica* germinates/m²**		
woodchips	15.62 ± 9.60	6.87 ± 4.41
spray/burn	4.91 ± 3.35	3.12 ± 1.43
mown	0	0
***Carex tasmanica* percentage cover**		
woodchips	6.70 ± 1.65	5.90 ± 1.42
spray/burn	4.71 ± 1.56	8.96 ± 2.67
mown	2.60 ± 1.09	5.30 ± 0.92
Percentage cover of exotic herbs		
woodchips	11.00 ± 2.73	17.40 ± 4.04
spray/burn	6.43 ± 1.25	11.71 ± 2.04 ¶
mown	31.20 ± 3.52	31.50 ± 3.49
Percentage cover of exotic rosette herbs		
woodchips	3.60 ± 1.82	5.70 ± 2.59
spray/burn	3.14 ± 0.71	7.86 ± 1.12 §
mown	22.80 ± 2.00	27.80 ± 2.72
Percentage cover of exotic grasses		
woodchips	18.20 ± 2.33	33.80 ± 5.47 ‡
spray/burn	10.04 ± 3.28	29.79 ± 4.94 §
mown	24.56 ± 3.66	36.53 ± 3.22 §

* Density, cover and number of germinants, and herb, rosette herb and exotic grass cover per square metre.
† Significance levels shown for the Mann-Whitney U Test (‡ = P<0.05, § = P<0.01, ¶ = P<0.001).

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