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IMPACT OF TRAMPLING ON BOLSTER HEATH COMMUNITIES OF MT FIELD NATIONAL PARK, TASMANIA

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(with four tables, one text-figure and three plates)

ABSTRACT

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The impact of trampling on the alpine bolster heath communities of Newdegate Pass and the Mt Field West plateau (1300-1400 m) were investigated. It was found that in the track vegetation, percentage bare ground was significantly higher, and percentage cover of some taxa and species diversity were significantly lower than in the surrounding undisturbed vegetation. Degradation was measurably worse on sections of the track subject to water-logging. Implications of these findings for recreational management are discussed.

INTRODUCTION

As leisure time increases and society becomes more urbanized the usage of national parks will increase. Natural vegetation varies in its ability to sustain use without degradation (Liddle 1975a, b). Alpine vegetation is particularly susceptible to damage caused by walking along tracks due to its slow growth rate and short growing season (Willard & Marr 1970a, Billings 1973, Liddle 1975b).

Calais (1981) studied the impact of walking tracks on the vegetation of the Cradle Mountain-Lake St Clair National Park. He found significant damage occurred to alpine heath communities with as few as 500 passages/year. This threshold was defined as that amount of trampling which reduces the vegetation cover sufficiently to expose soil to erosion without precluding recovery. Further use above this level results in erosion of the soil layer to pavement, from which recovery is exceedingly slow.

The present study looks at the impact of trampling on the bolster heath communities at Newdegate Pass (1300 m) and the Mt Field West plateau (1400 m) (42°41'S, 146°30'E). Visitor usage data are not available but vegetation damage from trampling is apparent.

The bolster heath of both sites occurs intermixed with areas of coniferous heath and lichen covered dolerite boulders. The major bolster species are *Abrotanella forsteroides*, *Donatia novae-zelandiae*, *Dracophyllum minimum* and *Pterygopappus lawrencii* which can occur alone or in complex mosaics. These species are highly branched chaemaephytes with extremely short internodes. They can easily support the weight of a man. Single bolsters may be up to 2.5 m in diameter and almost 1 m tall.

Both areas are flat or gently sloping, with an acid peat soil of about 0.5 m developed over Jurassic dolerite country rock. No direct climatic data are available but records from the nearest meterological station indicate an annual rainfall of about 1500 mm with a winter maximum, and mean annual maximum temperature of about 10°C and mean annual minimum temperature of about 0°C. Snowfalls can occur at any time of the year, and the soil profile can freeze to depths of 0.5 m in winter.

Species nomenclature follows Curtis (1963, 1967), Curtis & Morris (1975) and Costin *et al.* (1979) except where otherwise indicated. Structural terminology follows Kirkpatrick (1983). The term bolster rather than cushion plant has been used to denote the hard compact nature of these species compared with the much softer northern hemisphere cushion species.

Impact of Trampling on Bolster Heath Communities

METHODS

To assess trampling damage three paired transects were established at Newdegate Pass (NP1-NP3) and two paired transects on the Field West plateau (FW1-FW2). The paired transects consisted of a set of 20 contiguous 25 cm square quadrats laid down the centre line of the track with another set parallel to this but 2 m into apparently undisturbed vegetation. A further transect was run at right angles to the track and a levelled profile constructed.

With each quadrat species occurrence was recorded and percentage overlapping cover was estimated using 25 equal subdivisions. Where a cover value of less than 5% was recorded in the field a value of 2% was assumed for the purpose of analysis.

The data were analysed using the nonparametric 2-tailed Mann-Whitney U test to test for significant differences between percentage cover of species in the track and undisturbed vegetation for the combined data set from five paired transects (Siegel 1956).

The diversity index $N_2 = [(\Sigma x)^2]/\Sigma x^2$ of Hill (1973) was calculated for each paired transect, where x = percentage cover of each species which occurs. A similarity index was also calculated: C = a/c, where a = number of shared species, and c = total number of species.

RESULTS AND DISCUSSION

The communities at each transect are described in table 1. Species for which significant differences ($P < 0.01$) in mean cover values were found from the combined data set are shown in table 2. Differences in mean percentage bare ground are detailed in table 3. Species number in each transect pair, and diversity and similarity indexes, are shown in table 4.

The effect of walking on these bolsters is to wear a distinct track generally about 25 cm wide (plates 1 & 2, fig. 1). In all cases percentage bare ground is significantly higher in the track vegetation although the magnitude of this difference varies (table 3). Areas subject to continuous seepage such as NP3 and FW1 have the highest percentages of bare ground in the trampled areas. Indeed percentage bare ground appears to give an excellent index of the saturation of the bolster peats at any point of the track on areas of low slope (cf. Willard & Marr 1970a).

TABLE 1

TRANSECT VEGETATION
Description of plant communities and soil moisture.

Newdegate Pass Transect 1 (NP1):	*Microcachrys-Donatia-Oreobolus pumilio-Dracophyllum* bolster heath on a gentle slope rarely subject to waterlogging.
Newdegate Pass Transect 2 (NP2):	*Donatia-Dracophyllum-Pterygopappus-Empodisma* bolster heath on a gentle slope rarely subject to waterlogging.
Newdegate Pass Transect 3 (NP3):	*Empodisma-Dracophyllum-Donatia* bolster heath on flat subject to continuous seepage.
Field West Transect 1 (FW1):	*Donatia-Dracophyllum-Empodisma-Celmisia saxifraga* bolster heath on flat subject to periodical waterlogging.
Field West Transect 2 (FW2):	*Dracophyllum* bolster heath on slight slope, rarely subject to waterlogging.

Plate 1 - Track through *Microcachrys* bolster heath at Newdegate Pass Transect 1.

Plate 2 - Damage of track through waterlogged bolster heath at Newdegate Pass.

Plate 3 - Damage to bolster wall of tarn at Newdegate Pass resulting from track.

TABLE 2

PLANT TAXA
Combined list of taxa showing those for which a significant difference between track and undisturbed vegetation exists.

*Empodisma minus****
*Celmisia saxifraga****
Lichen spp.***
*Pterygopappus lawrencii****
*Erigeron stellatus****
*Epacris serpyllifolia****
*Cyathodes dealbata****
*Gentianella diemensis****
Rhacomitrium spp.***
*Celmisia longifolia****
Moss spp.**
*Danthonia pauciflora***
Carpha spp.**
*Oreobolus pumilio**
*Dislaspis cordifolia**
Donatia novae-zelandiae
Dracophyllum minimum
Michrocachrys tetragona
Drosera arcturi
Carpha alpina
Garmedia fitzgeraldii F. Muell. & Rodway
Sprengelia incarnata
Mitrasacme archeri
Actinotus suffocata
Pentachondra pumila
Oreobolus acutifolius
Astelia alpina
Drimys lanceolata
Unidentified grass spp.

* $P \leq 0.01$ ** $P \leq 0.001$ *** $P \leq 0.0001$

Except for NP3 and FW1 transects, bare ground resulted from the death of bolster species on the track and not from disruption of the soil profile. In NP3 and to a lesser extent FW1 the soil profile has become churned by boot traffic especially at times of saturation of the soil profile.

No species had a higher mean cover in the track vegetation. Those significantly lower are listed in table 2. The taxa that were most noticeably reduced were *Empodisma minus*, *Celmisia saxifraga*, lichen spp., *Microcachrys tetragona* (highly significant in NP1 but not reflected in the combined data). Other species which were also highly susceptible are *Pterygopappus lawrencii*, *Erigeron stellatus*, *Epacris serpyllifolia*, *Cyathodes dealbata*, *Gentianella diemensis*, *Rhacomitrium* spp. and *Celmisia longifolia*. Some of these species had low cover values. The harder bolster species *Donatia novae-zelandiae* and *Dracophyllum minimum* are generally more resistant. These results are in strong agreement with those of Calais (1981) and generally support the assertion of Liddle (1975) that plants with basal apices and meristems tolerate trampling better than those which do not have such structure.

The lesser number of species on the tracks is generally a reduction rather than substitution of different species in the track vegetation (table 4). This is further indicated by the high values of the similarity index (table 4). The lower value for NP3 reflects the drastic reduction in number of species in the track vegetation. Similar reduction of species on tracks has been documented elsewhere (Hoffman & Alliende 1982).

TABLE 3

PERCENTAGE BARE GROUND

	NP1		NP2		NP3		FW1		FW2	
	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd	$\bar{x}$	sd
Undisturbed vegetation	0.60	1.96	0.00	0.00	0.80	1.69	0.00	0.00	3.72	3.40
Track vegetation	8.92	8.64	23.40	16.52	82.40	12.88	45.40	16.24	26.00	19.00

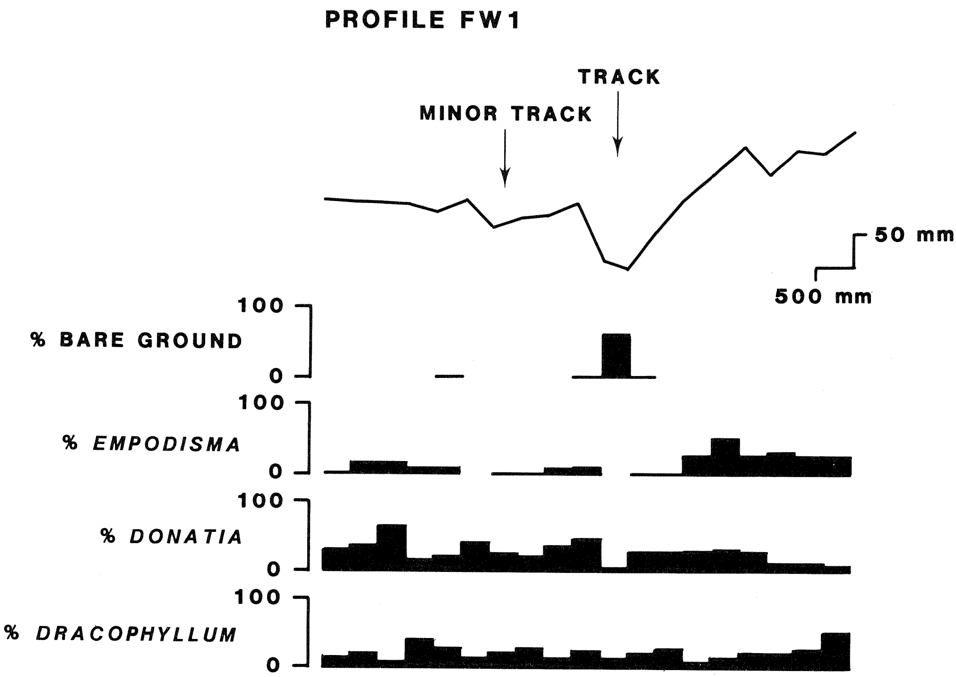

FIG. 1 - Profile transect of Field West transect 1 (FW1) showing percentage bare ground and percentage cover of dominant taxa, *Empodisma minus*, *Donatia novae-zelandiae* and *Dracophyllum minimum*.

The diversity index (table 4) shows a wide spread for these bolster heath communities reflecting their large degree of heterogeneity. In every transect however the diversity index of the track vegetation was lower than that of the undisturbed vegetation. Others have reported a variable response of diversity to trampling, depending on such factors as intensity of wear and condition of untrampled controls (Liddle 1975a).

CONCLUSIONS

This study has shown that damage to bolster heath communities, resulting from walking tracks, is variable. Sites with high soil moisture show the greatest damage. Indeed these sites, even with present relatively low usage, are at a critical stage because the soil profile, generally of a somewhat structured peat, is breaking down and eroding (Liddle 1975a, Willard & Marr 1970a, Calais 1981). It has been reported by others that once soil disturbance has occurred re-establishment is very difficult and slow (Billings 1973), perhaps of the order of hundreds of years (Willard & Marr 1970b).

On the low slope areas of Newdegate Pass and the Mt Field West plateau trampling on most sections of the track has not destroyed more than 50% of vegetative cover nor broken down the soil profile. Thus present usage is at or below the carrying capacity of this area, where carrying capacity is defined as the annual net primary production being equal to or greater than the annual amount of plant material destroyed by trampling. This is not the case on the wetter sections of the track where moderate levels of damage are apparent and tracks are beginning to spread laterally.

TABLE 4

NUMBER OF SPECIES, DIVERSITY INDEX (N_2) AND SIMILARITY INDEX (C). Definitions of N_2 and C are given in the text.

		NP1	NP2	NP3	FW1	FW2
Number of species	Undisturbed vegetation	21	21	23	16	12
	Track vegetation	17	17	8	16	8
N_2	Undisturbed vegetation	5.76	6.31	7.26	7.41	1.42
	Track vegetation	4.96	3.71	3.70	4.01	1.13
C		0.73	0.81	0.35	0.78	0.75

The data argue for the re-routing of tracks around persistent wet areas or installation of raised boardwalks. These measures would also protect associated geomorphological/ biogeomorphological features, notably the small and fragile tarns dammed back by the bolster plants (plate 3).

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