THE EFFECTS OF ALPINE GRAZING ON CONSERVATION VALUES

THE RESEARCH BEHIND THE DEBATE

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ALPINE GRAZING AND CONSERVATION

The Victorian National Parks Assoication has long opposed the continuation of grazing in the sensitive Alpine Vegetation. This report shows how the work of many scientists supports our stand.

The research shows:

- damage to sphagnum bogs
- creation of bare ground and damage to soils
- serious erosion in some areas
- changes in vegetation structure
- loss of species and diversity
- reduction in apline flowers

Thus we believe that grazing should be phased out from areas designated as National Parks as this use conflicts with the primary objective of conserving Flora and Fauna.

THE EFFECTS OF ALPINE GRAZING ON CONSERVATION VALUES

THE RESEARCH BEHIND THE DEBATE

JENNY BARNETT ... June 1987

Since the mid-fifties the question of grazing in the south- eastern Australian alpine region has been the subject of over 30 papers, reports and reviews. The various investigations have used a variety of methods including surveys and observations, comparison with historic records, detailed monitoring of vegetation after removal of grazing pressure, long-term comparisons between grazed and ungrazed plots, experimental plots, and examination of the behaviour and diet of cattle on the high plains. This document examines the results of these research methods and discusses the choice between phasing out or continuing grazing. Only the principle source papers are considered here rather than those that are purely literature reviews.

In summary cumulation of 30 years of research on the effects of alpine grazing reveals;

- deterioration of sphagnum bog areas,
- an increase in bare ground,
- serious erosion in some vegetation communities,
- loss of species and diversity,
- changes in vegetation structure,
- an increase in shrubs in some vegetation communities,
- damage to soils,
- reduction in alpine flowers.

SURVEYS AND OBSERVATIONS

Early Research

Extensive qualitative surveys and assessment of habitat damage were conducted by Alec Costin, a C.S.I.R.O. scientist who later worked with the Victorian Soil Conservation Authority and the Australian National University. Costin examined sites all over the NSW and Victorian Alps, repeatedly finding evidence of grazing damage to many of the habitats including the sod tussock grasslands and alpine herbfields (Costin 1957). Costin reported especially serious trampling and erosion in snow patch vegetation and universally severe damage to sphagnum bogs except where inaccessable to stock. Whilst Costin put down much of the damage to bogs as a combination of fires and grazing he points out that noticeable recovery was occuring in fenced-off areas in constrast to adjacent grazed bogs (Costin *et al.* 1959). Measurements of vegetation in alpine grassland before and after grazing and observations on stock grazing (Costin 1958, Costin *et al* 1959) led him to conclude that stock were altering the floristic structure by selectively grazing the major (more dominant, usually taller) herbs. Various minor (less dominant, usually smaller) herbs, better adapted to semi-bare ground, then invaded, including several exotic species. Costin considered this effect to be worse with sheep as they grazed more closely but pointed out that cattle caused more severe damage by trampling.

Twenty years later after an inspection of the Bogong High plains Costin (1977) again found widespread slight to moderate damage to grassland and herbfield, locally severe deterioration of mossbeds and snowpatch vegetation and that the condition of the vegetation cover and soil had not noticeably improved. This was in contrast to the adjacent Loch-Hotham area where grazing had ceased nearly 20 years earlier. He concluded that the stocking rate on the Bogong High Plains was preventing or at least retarding satisfactory recovery, even though sheep were prohibited since 1947 and cattle much reduced.

A recent quantitative survey by Keith McDougal of the Soil Conservation Authority (McDougal 1982) described and measured the vegetation structure of the various plant communities on the Bogong High Plains and estimated the proportion of the area occupied by each community. A description of the disturbance susceptibility was given for each, including damage observed from cattle grazing and trampling. Whilst some communities were judged as being resistant to damage eg. the *Poa constiniana* and *Poa fawcettiae* closed tussock grasslands, and some were protected by rocky terrain from cattle access, many other communities comprising over 30% of the area were considered highly susceptible to grazing, trampling or smothering by cattle faeces. Another 45% showed some damage in the form of

tracks, bare areas, or larger than normal numbers of introduced species (*See Table 1 Page 45).* However, even within those communities listed by McDougal as "resistant" it must be remembered that this judgement is based largely on susceptibility to soil erosion rather than considerations of whether grazing has altered vegetation structure.

Richard Williams, a recent postgradute student from the Melbourne University Botany School also examined the distribution and composition of plant communities on the Bogong High Plains. He undertook extensive transect and quadrat sampling in woodland, heathland, herbfield and grassland communities (Williams 1985, Williams and Ashton 1987). He concluded that there were four basic vegetation types:

- woodlands/dense closed heaths with tall shrubs such as *Prostanthera* (Alpine Mint Bush) and *Phebelium*,
- closed heaths of *Grevillea* and *Phebalium*,
- open heathland of *Grevillea* and *Poa* (snowgrass),
- tussock grasslands dominated by *Poa*.

He found the change from dense closed heaths to grassland was sometimes sharp and probably reflected topographic/exposure factors but that often there was a broad continuum through open heathland between the grasslands of the more exposed sites and the dense heaths of the more sheltered sites. From examining the patterns of succession in grazed and ungrazed areas and on experimentally disturbed sites (see below), he concluded that where there was such a continuum cattle could increase the proportion and density of heathland by increasing the number of shrubs that became established in these areas.

HISTORIC RECORDS

Both Alec Costin and Stella Carr, another early botanist researching alpine grazing, list a number of plants from early records that were formerly common, but became rare or locally extinct. These include Ribbony Grass *Chionochloa frigida*, Mountain Celery *Aciphyla glacialis*, the Anemone Buttercup *Ranunculus anemoneus*, Mountain Lettuce *Podolepus robusta*, and Yellow Eyebright *Euphrasia scabra* (Costin 1958, Carr and Turner 1959b). Some of these have made a dramatic recovery within the Kosciusko National Park after the cessation of grazing (Costin *et al.* 1959, Costin *et al.* 1979). One species, the anenome buttercup is now locally common in Kosciusko but appears to be extinct in Victoria.

Other historic accounts give records of fens (sedge filled swampy areas) that have vanished, extensive sphagnum bogs now reduced and vegetation on areas that are now largely bare (see Costin *et al.* 1979). Costin points out that other evidence, such as relic bog vegetation and unnecessary detours in snow pole lines, also indicates many bogs which no longer exist.

A general increase in shrubs on the Bogong High Plains from that existing in the past was noted by Carr (1962) and is supported by comparison of aerial photographs between 1936 and 1980 (Williams 1985) with old photographs from the 1930's and 40's (van Rees 1984).

MONITORING OF VEGETATION AFTER THE CESSATION OF GRAZING

Two long-term studies have examined the response of vegetation to the removal of grazing pressure by setting up transects and quadrats for regular measurements of species composition and and density of cover.

The first of these was in the Kosciusko National Park and recorded plant successions in both alpine and subalpine vegetation (Wimbush and Costin 1979b, 1979c). The study continued for 20 years after the cessation of sheep and cattle grazing and regular burning off. An alpine area where these practices had been removed 15 years earlier was also monitored for 20 years.

The main findings of the Kosciusko study were:-

- an increase in the number and abundance of major and intermediate herbs.
- an initial increase followed by a long-term reduction of minor herbs including some exotic weed species.
- a progressive decrease in the amount of bare ground.
- increases in shrubs in general proportion to the amount of bare ground initially exposed. The main colonisers of large areas of bare ground were leguminous shrubs.
- senescence of shrubs without regeneration on some transects where competition from perenial herbs increased, and suppression of shrub development where there was already dense snowgrasses and herbs.
- recovery of bogs as regeneration of sedges blocked previously eroding streamlines enabling the water table to rise and sphagnum and other water dependant species to regenerate.

TABLE 1.

Plant communities on the Bogong High Plains and their susceptibility to damage (derived from McDougal1982) arranged in approximate order of susceptibility.

Plant Community and unit no.	% of area	Comments by McDougal
1 *Podocarpus* heathland	<1	The unstable nature of the basalt rocks protects the vegetation from any damage from cattle.
3C *Grevillea* scree heathland	10	Most of the areas where this vegetation occurs have been withdrawn from grazing.
13 *Poa hothamensis* (rocky) grassland	<1	Most stands are inaccessible to cattle because of their steep unstable locality.
14 *Epacris microphylla* heathland	<1	The vascular flora of this unit appears to be resistant to disturbance by grazing and trampling.
15 *Poa fawcettiae* tussock grassland	<1	The unit appears to be highly resistant to grazing and trampling.
5A *Poa constiniana* tussock grassland	5-10	appears to be more resistant to compaction and destruction by cattle faeces...In areas of intense cattle activity ...many tussocks have been removed.
7B *Epacris glacialis*	<5	Very little bare soil...is probably fairly stable heathland
8A *Pratia* depressions	<1	Although much soil is exposed, it is surprisingly stable ...the effect of cattle is probably minimal.
11 *Celmisia sericophylla* herbland	<1	endemic...virtually restricted to the Bogong High Plains ...Although cattle tracks traverse most stands the dense cover appears to be fairly stable. Some stands ...contain plants rare to Vic. Protection of this unique unit is essential.
12 *Carex appressa* sedgeland	<1	Bare soil is rare except in wet areas where hooves may penetrate to more than 10 cm...soils and vegetation appear to be resistant to disturbance.
2 *Phebalium-Bossiaea* closed heathland	20	Although tracks result, caused by trampling of shrub layer little or no erosion occurs...such tracks, however, permit the establishment of opportunist species.
3A Heathland/tussock grassland	20	Increased accessibility makes this unit more prone to cattle damage..Bare ground is not uncommon but substantial loss is rare...however some soil loss is likely on all but flat sites.
3B *Hovea* basaltic heathland	<1	Some trampling of shrubs...bare soil surfaces not depressed. A larger than normal number of introduced species is characteristic...
9 Subalpine (exotic) grassland	<5	All stands...contain large amounts of introduced species ...bare ground is minimal...There is a noticeable absence of bog vegetation...

TABLE 1 [Continued]

Plant Community and Unit Number	% of Area	Comments by McDougal
5B *Poa hiemata* tussock grassland	10	Highly susceptible to disturbance ... Areas are left bare after decomposition of faecal deposits ... which ultimately means a continual loss of soil.
5C Tussock grassland/ mat heathland	5	Destruction of *Pentachondra* mats...at least some attributable to smothering by faeces. Disruption of the carpet results in the exposure of bare soil.
5D Short turf snowpatch	1	often grazed almost to ground level...Bare soil accounts for a considerable portion...soil loss is not always obvious...however massive soil loss has occurred from a few short turf snow patches.
4 *Kunzea* heathland	5	readily damaged by trampling...tracks have become depressed as much as 10 cm...continued trampling will ultimately result in widening of tracks and deterioration of the cover.
6 Diuturnal snowpatch	<1	Bare soil is frequent...soil loss is apparant. cattle tracks...have become severely entrenched... This...is one of the vegetation types most susceptible to disturbance by cattle or man.
7A Bog	10	most damage is caused by trampling...repeated trampling can lead to *Sphagnum* destruction...widespread destruction is likely to be irreversible.
8B Fen (Bog pool)	1	Towards the end of summer...much trampling of the moist peaty soils occurs. This often leads to destruction of pool species.
10 *Caltha* herbland	<1	this unit is very restricted...The *Oreobolus* cushions are particularly susceptible to trampling ...without adequate protection they may rapidly disappear.
16 *Hovea* heathland	<1	numerous cattle tracks, many of which are severely eroded...*Hovea* shrubs are low and easily trampled. Further substantial soil losses are inevitable...with continued grazing.

- some species that were absent or barely present in the first survey showed steady and sometimes spectacular increases. These included species of Billy Buttons *Craspedia* spp., Eyebrights *Euphrasia* spp. , Groundsels *Senecio* spp., and the reappearance after 20 years of Mountain Gentian *Gentianella diemensis*, Bluebells *Wahlenbergia* spp, and the Anemone Buttercup.
- A period of at least 50 years is probably needed before development of vegetation close to the original undisturbed condition.
- in severely disturbed and eroded sites shrubs may persist and a full recovery to the original vegetation may not be possible.

A similar, although less detailed study, was set up in 1960 by the Victorian Soil Conservation Authority in the Mount Hotham area immediately after grazing was withdrawn. Between 1960 and 1972 (Soil Conservation Authority 1972) the ground cover had increased by 12.3%. This was mainly due to increases in the shrubs (7.7% - principally Yellow Kunzea *Kunzea muelleri* and Alpine Grevillea *Grevillea australis*) and herbs (5.6%) including *Celmisia astelliifolia*, the Silver Snow Daisy.

COMPARISONS BETWEEN GRAZED AND UNGRAZED PLOTS

These studies are similar to the last category in that permanent transects and quadrats are used to record changes after the removal of grazing but have the added advantage of having measurements in grazed plots for direct comparison.

Long Term Studies

The earliest plots were set up in a joint project by the University of Melbourne Botany School and the Soil Conservation Authority when. Two areas were fenced off from cattle on the Bogong High Plains in 1946 at Pretty Valley (8x50m) and Rocky Valley (7 ha). Adjacent grazed areas were marked out for simultaneous measurement. The progressive results for over 30 years have been reported in a series of papers; Carr and Turner 1959b, Carr 1977, van Rees et al. 1984, and Williams 1985.

A second study was initiated by the C.S.I.R.O. in 1957 when plots were established in Kosciusko National Park. In this case plots were fenced in an area where grazing was being removed (Dainers Gap) and in a nearby area where grazing had ceased 18 years earlier (Hotel Kosiusko Water Reserve). Sheep grazing was then conducted within them for 14 and 8 years respectively and regular measurements taken both inside and outside in adjacent ungrazed plots (Wimbush and Costin 1979a).

In both these studies the major changes in the plots from which grazing had been removed included many of those outlined above. At Dainers Gap bare ground decreased significantly and the cover and number of species of major herbs increased. Minor herbs initially increased and then declined including some exotic weed species. However at Dainers Gap shrubs did not establish except where soil was significantly eroded. At Pretty Valley the ungrazed plot changed from a short grassland to a low open heath with a reduction in bare ground and substantial increases in shrubs (mainly Alpine Star Bush *Asterolasia trymalioides*) and major herbs (mainly Silver Snow Daisy). The Rocky Valley plots are less well documented but from Carr (1977) and Williams (1985) a dramatic increase in shrubs, increased luxuriance of vegetation, increased complexity of structure and a gradual recovery of the enclosed mossbed occurred.

Although the grazed plots at Kosciusko were stocked with sheep whilst those at Bogong supported free-ranging cattle, nonetheless some results were similar; the extent of bare ground in the intertussock spaces showed no real sign of improvement, and cover by some major herbs remained well below that obtained by the ungrazed plots. At both Dainers Gap and Pretty Valley several species of herb that appeared in the ungrazed plot remained absent in the grazed plot and at the Hotel Kosciusko Water Reserve the cover of major herbs was reduced by the onset of grazing.

In contrast, the response of shrubs in grazed and ungrazed plots varied between areas. At Dainers Gap shrubs spread significantly more on the grazed than the ungrazed plot whilst at Pretty Valley the reverse was true. In the dense tussock grassland of the Hotel Kosiusko Water Reserve shrubs remained sparse in grazed and ungrazed plots whilst at Rocky Valley there was a vigorous increase in shrubs in both grazed and ungrazed areas of grassland and snowpatch vegetation.

Effects on Soil

Both the above studies measured the bulk densities and organic matter in the soil of the grazed and ungrazed plots. Both found soil in ungrazed plots after 10 years had more organic matter and was less dense; in other words a lighter richer soil that was more easily penetrated by water and plant roots, in contrast to the more compacted soils of the grazed areas.

A Study on Grasslands

A recent study of 8 grazed and one ungrazed grassland sites on the Bogong High Plain (van Rees et al. 1984) suggests that the grassland vegetation is stable under the existing grazing pressure with no trends in the balance of species or vegetation cover and luxuriance. However in interpreting these claimed results the following points should be borne in mind:-

- The plots were monitored at 1-2 year intervals for only 5 years and 4 of the 8 grazed plots had only 2 measurements 3 years apart.
- The plots had been subject to grazing for over 120 years so some form of equilibrium could be expected to have become established. This tells nothing of what plants and vegetation structure was originally present or what would return if grazing is removed.
- The "control" ungrazed plot in which grazing ceased 5 years earlier was over 10 km from the nearest grazed plot and was situated on an exposed ridge at a higher altitude (1920m cf 1650—1840m). Thus this plot which showed little change (pointed out by the authors as a probable result of its greater exposure) cannot indicate the impact of grazing or the possible result of removing grazing from the area as a whole.

The data presentation and analysis in both this paper and another subsequently derived from it (van Rees et al. 1985) have several serious deficiences including:-

- During data collection only the six species that were considered by van Rees to be regularly grazed by cattle and those species providing more than 5% cover at the particular site were recorded separately; all other species were pooled as "monocots", "forbs" or "shrubs". Thus any change in less common species could not be detected.
- Only selected data are given. Data from year to year are not presented for any species or group of species at all sites with the exception of Poa spp. Even the data for species stated to be important cattle food plants are most incompletely presented; data on the cover of the Silver Snow Daisy *Celmisia asteliifolia* is given at 5 of the 9 sites only, Scaly Buttons, *Leptorynchos squamatus* at 4 sites, Alpine Wallaby Grass, *Danthonia nudiflora* at 2 sites, Alpine Star Bush, *Asterolasia trymaloides* at only one site with no data at all for the Alpine Grevillea *Grevillea australis*. It is therefore difficult to have much confidence in the statement of the authors that "these preferred forage species have not changed in cover at the sites measured indicating that the growth of these species is keeping pace with their consumption".
- Similarly both papers make statements about significant fluctuations in the luxuriance of some species from year to year with no significant trends, but present no data whatsoever to support the statements made.
- Even in the limited data presented by van Rees et al (1984) obvious trends in the cover of some plants at some sites can be seen (eg. decreases in *Carex* spp., "other Monocots" and "other forbs" at site 7) that are not acknowledged by the authors. Thus the authors' statement that "for the data presented there were no measurable trends in overlapping cover and average luxuriance for any of the major species or groups of species" is again hard to believe. One is also left wondering about what is contained in all the data not presented.

A Study on Shrubs

Richard Williams, as part of his work on the dynamics of shrub and grass communities, studied the patterns of growth and regeneration of shrubs in three grazed and one ungrazed heathland communities (Williams 1985). He found that in the absence of disturbance senescent shrubs of the generally more exposed communites (*Grevilea* and *Phelebium*) were usually replaced by Poa but that cattle grazing could favor their replacement by more shrubs. However in the closed heaths of steep sheltered sites dominated by Alpine Mint Bush (*Prostanthera cuneata*) the senescent shrubs were normally replaced by more shrubs, with or without grazing, thus resulting in a more persistant community.

A Question of Rabbits

Finally some very recent work by C.S.I.R.O. using grazed and ungrazed plots at Kiandra Plain in the northern part of Kosciusko National Park is worth mentioning. In this case the herbivore tested is not domestic stock but the feral rabbit. Whilst rabbits keep mostly below the treeline (about 1800m) and are not particularly prevalent even in the sub-alpine woodlands, this work is important because the quantitative impact of the rabbit was unknown. Cattlemen have often argued that at least some of the observed grazing damage is due to rabbits and not to their cattle, and without such a study it is difficult to fully resolve this issue. This study was at the relatively low altitude of 1550m.

In this study (Leigh et al. 1987 in press, cited by Bell 1987) plots were set up for 4 grazing treatments. These were:-

1. total exclusion of all grazing by rabbit proof fences;
2. grazing by a known number of rabbits enclosed by a fence (7- 8/ha; considered a "moderate" number);
3. grazed by feral rabbits only (a wide meshed fence excluded larger native herbivores but not rabbits);
4. grazed by both feral rabbits and native herbivores (no fence).

The number of rabbits present in the last two treatments was estimated by regular collection and counting of rabbit droppings.

Finally for each of these treatments the effect of control burning was also tested and compared with unburnt plots. Twenty- four half hectare plots were set up, thus each of the 8 treatments had 3 replicates.

The first finding was that there was little or no difference between the completely unfenced plots and those with wide mesh fences; in other words the native herbivores were having negligible impact. The second important finding was that rabbits could cause a substantial reduction in the cover and biomass of palatable herbs and in the plots where the rabbits were artificially confined, 9 of the 106 species were eliminated. In constrast 2 new species appeared in the fully fenced ungrazed plot. However results from the plots available to feral rabbits indicated that:-

- burnt areas attracted far more rabbits than unburnt plots and damage to burnt plots from feral rabbits was greater than in unburnt plots (see Fig 1). Burning thus exacerbated the damage done by feral rabbits and vice versa.

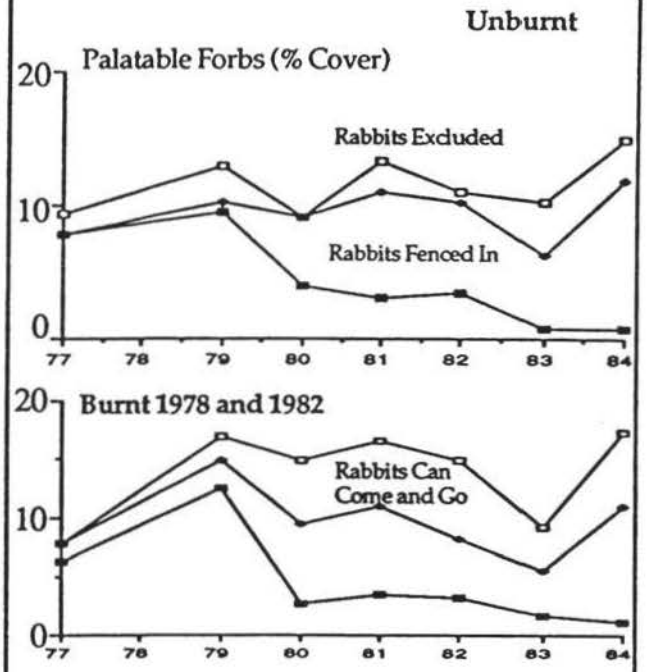
- the damage done by feral rabbits even in burnt areas was not as great as that where the "moderate" number of rabbits were artificially fenced in (Fig 1). This suggests there is some natural regulation of rabbit grazing as the preferred plants are eaten.

- In unburnt plots with free rabbit access the cover of herbs is only slightly below that of plots where grazing is excluded (Fig 1).

The researchers conclude from this study and from past surveys of rabbit numbers that rabbits may depend on fire to maintain their numbers and that left alone the subalpine country may almost rid itself of rabbits. They consider that the bitter conditions without the fire induced food source of fresh growth will almost wipe them out and the few remaining burrows could be poisoned to assist in this process.

Thus although rabbits can cause substantial damage it is unlikely that these will have more than a minor impact in the higher areas (above 1800m) or in those areas which have remained unburnt for a substantial period such as on the Bogong High Plains.

FIGURE 1.



These data pertain to frost hollow, but a similar picture emerged for woodland.

EXPERIMENTAL PLOTS

The general observations by earlier researchers that shrubs were becoming more common and that these often established on bare areas lead to the postulation that damage by cattle was encouraging this change (Carr 1962, 1977; Wimbush and Costin 1979b,c). The sudden expansion of shrubs in some areas after grazing ceased was attributed to a combination of this damage and the fact that whilst cattle were present trampling and grazing slowed down, but did not completely prevent, the establishment and growth of some shrubs. A recent researcher from Melbourne Botany School set out to test this hypothesis by simulating damage to vegetation, and measuring the results both with and without continued cattle access (Williams 1985).

The Experiment

Williams subjected a series of one metre square plots to the folowing treatments:-

1. Bare ground plots in which all vegetation was pulled out. (This simulated the bare areas that were more common in areas where cattle were present eg. cattle tracks.)
2. Poa litter plots in which the snowgrass tussocks (*Poa hiemata*) were clipped and the clippings laid on the plot and secured by a nylon mesh. (This simulated damage from casemoth and swiftmoth attack. These sometimes severe attacks result in the leaves of snowgrass falling to the ground where they remain in a mat unless disturbed. Occasional patches of insect attack are the most noticeable form of damage other than bare ground observed in the grasslands.)
3. Control plots in which the vegetation was left undisturbed.

Plots were set up in in open heathland (mainly snowgrass, few scattered shrubs present) and closed heathland (many shrubs present, small snowgrass patches). Half of the plots for each treatment were enclosed in a fence excluding cattle but not smaller herbivores such as hares. A total of 120 plots were set up in 1980 after recording and photographing the vegetation initially present, and the subsequent return or change in species and vegetation cover was measured each autumn until 1983.

The Results

The principal findings of the experiment were:-

- Where the vegetation remained intact (control plots) or the ground remained closely covered with litter (*Poa* litter plots) the establishment of shrubs was negligible.

- When the litter remained intact on the *Poa* litter plots there was substantial recovery of *Poa*.

- In the grazed open heath areas damage to the nylon mesh in the *Poa* litter plots, presumably due to cattle, resulted in loss of litter and a few shrub seedlings established on the exposed ground.
- In the bare ground plots there was substantial establishment of seedlings of several species of shrubs and also vegetative sprouting of the shrub *Hovea longifolia* if these had been previously present. Vegetative and/or seedling establishment of sedges, various other herbs and *Poa* also occurred, however the survival of the Poa seedlings in these plots was minimal.
- At the end of three years shrub seedlings in the open heathland were more numerous in the bare ground plots that were protected from grazing.

Thus shrub germination was not favoured except where bare ground was present and the survival of the shrubs after germination was enhanced in the open heathland if they were protected from cattle. The results also suggested that disturbance by cattle of insect damaged vegetation may result in bare ground and shrub establishment that otherwise may not have occurred.

The Implication

From Williams other work (see above) he concluded that whilst factors such as soil, topography and exposure were the major determinant of distribution of heaths and grasslands there was a continuum of communities in many sites (some 30% of the Bogong High Plains) in which the proportion of shrubs may be influenced by disturbance. The results of the experiment suggested that disturbance resulting in bare ground including cattle trampling, grazing and damage by urine and faeces constantly initiated the germination of shrubs and disturbed the normal succession in which senescent shrubs were replaced by grasses and herbs. Thus cattle grazing resulted in the vegetation remaining permanently in an earlier successional stage that would normally result from far less frequent natural disturbances such as fire and severe insect attack.

BEHAVIOUR AND DIET OF CATTLE

Harm van Rees, from Melbourne Universit School of Agriculture and Forestry, examine alpine grazing using a cattle based study. Th findings and limitations of the two main aspec of his study are examined below.

Behaviour

Van Rees investigated where cattle went, t proportion of time spent in different habitats ar their main activities within them (van Re 1984, van Rees and Hutson 1983). This w measured by regular spot recordings of t locations and activities of cattle in two areas the Bogong High Plains (at Cope Creek and n Mt Nelse) and by following and continuou recording the location and activity of sin animals. The amount of time spent in e habitat was then compared with the proport of that habitat in the area as a whole - a

hence whether the cattle showed preferences for, or avoided, any particular habitats. Van Rees found:-

- Grazing cattle spent most time in grassland, wet grassland, open heathland and closed heathland with grassland being the most consistently preferred.
- As most of the free flowing water accessable to cattle was in mossbeds, cattle by necessity used mossbeds for drinking.
- Cattle spent around 5% of their time in mossbeds which occupied about 10% of the area. Thus they showed some degree of avoidance of these areas when not drinking.
- Whilst mossbeds were not a prefered habitat for grazing, nonetheless most cattle grazed on their way through mossbeds and a small proportion entered to graze rather than drink.
- During the dry year of 1982-3 mossbeds were used more by resting cattle than during the preceding two years, probably because of their attractiveness as cool resting places.

The main limitation of these data taken on their own is that they are insufficent to indicate the likely impact of the cattle on the various habitats. The length of time spent in a habitat is only one of the two factors to consider; the other factor is the relative sensitivity of the habitat. However this information is most useful when combined with findings of other researchers (see Summary of Research and Discussion).

Diet

Van Rees assessed the diet of cattle on the high plains by three methods;

1. direct observation of grazing cattle and examination of grazed areas.
2. Analysis of faecal samples.
3. Analysis of material freshly ingested by cattle, collected by the implantion of oesphageal fistulas (a resealable opening, surgically installed in the throat to enable food samples to be taken).

The principal findings of this study (van Rees 1982, 1984, van Rees and Holmes 1986) were:-

- Cattle were highly selective in their dietary preferences.
- *Poa hiemata* (snowgrass) constituted an important part of the diet but, particularly in grassland, was generally grazed less than its availability. Its contribution to the diet declined through the season.
- The herb *Celmisia astellifolia* (Silver Snow Daisy) formed a major part of the diet (up to 40% of dry weight); far more than its percentage cover in most grassland and heathland. Its contribution increased through the season.
- Other important components of the diet were the herb *Leptorhynchos squamatus* (Scaly Buttons), the shrubs *Grevilea australis* and *Asterolasia trymaliodes* (Alpine Grevilea and Alpine Star Bush), the grasses *Danthonia nudiflora* and *Poa hothamensis* (Alpine Wallaby Grass and Ledge Grass) and sedges *Carex* ssp..
- In mossbeds cattle mainly ate sedges *Empodisma minus* and *Carex guadichaudiana* and Prickly Snow Grass *Poa constiniana*.

Whilst this information on the major components of the cattle diet is valuable it throws little light on the effects of grazing on conservation values because only the more commonly eaten species were capable of being detected by the three methods used. Many plants, especially the rarer species would be amongst the *"unknown fragments"* in the faecal and fistula samples. The study is based on the needs of the cattle rather than on the ability of the environment to withstand this pressure; for instance when discussing the statistical analysis it is stated that only species that constitute more than 5% of the diet are included because species that did not meet this criteria would "not have a significant effect on the nutritional status of the steers". The effect of the steers on the less common plant species is never considered. The author's final conclusion on the impact of grazing that "the most commonly grazed species are common components of the alpine vegetation" is therefore too simplistic; the commonly grazed species of the past may be at risk or even gone.

Other Aspects

The study briefly covers a few matters that do have some bearing on nature conservation. These include the observation that cattle camps (where salt licks are provided) may be denuded and have a high level of weeds, the finding that 11 weed species germinated from cattle faeces even when stored for 15 months, and the observation that severe scalding of vegetation could sometimes result from urine patches,leading to bare ground. The persistence of cow pats for at least 4 years is also reported although the author disputes the finding of McDougal (1982) that these can lead to bare ground as vegetation (including weeds) eventually grew through them. He failed to consider, however, the likely result if the pats are dislodged before this happens - even though he cound only find 30 of the 40 pats he had under study.

SUMMARY OF RESEARCH FINDINGS

The cumulation of 30 years of research reveals the following main effects of the practice of alpine grazing:

- Deterioration of sphagnum bog areas.
- An increase in bare ground in many vegetation communities.
- Serious erosion in some vegetation communities.
- Loss of species.
- Changes in vegetation structure.

These are all supported by historical records, the damage observed by past researchers, the reversal of this damage in areas fenced off or withdrawn from grazing and the return of species, changes in species abundance and increase in structural complexity (more species found at any one point) found in these ungrazed areas.

- **An increase in shrubs in some vegetation communities.**

This is supported by photographic records, observations of several researchers and by the experiments and surveys of Richard Williams.

- **Damage to soils.**

In addition to damage by erosion, soil analysis studies revealed a loss of organic matter and increased soil density in grazed areas, reducing water infiltration capacity.

- **Reduction in alpine flowers.**

As well as the loss of species and reduction in abundance of many plants (including some spectacular major herbs) several researchers reported that cattle preferentially ate the flowers of many of the remaining herbs and also some shrubs in autumn when the next season's buds are forming. The spectacular displays of flowers now experienced in Kosciusko National Park may indicate the impact of the cattle on this aspect. Some researchers consider the subsequent effect on seed production may seriously disadvantage some species.

DISCUSSION

From all of the research presented above it can be seen that a substantial body of research indicates that alpine grazing has had a significant deleterious effect on conservation values and continues to have this effect. Apart from scientific values, aesthetic values such as the enjoyment of the wildflower enthusiast are adversely affected. The continuation of this practice in a National Park, where the primary objectives are nature conservation and recreation, must therefore be seriously questioned.

A recent book (Jameson, 1987) rejects this contention (and most research) claiming that cattle grazing benefits the environment and fire protection. However this book relies heavily on the cattle orientated research of van Rees (1984) and the incomplete vegetation study of van Rees et al. (1984). The former is not designed to assess conservation values and the latter has many inadequacies (see above). The book also interprets van Rees's finding that the cattle exhibit some avoidance of sphagnum bogs to imply they have little impact on bogs. This completely ignores the high susceptibility to trampling of these areas. To make an analogy - a bull does not have to spend long in a china shop to become an unwelcome guest! The last major contention of this book that rabbits are a major culprit for the damage attributed to cattle has been negated by the recent C.S.I.R.O. study (see above). Rabbits are absent above the tree line and in the absence of fire dwindle to insignificant numbers in the subalpine zone. For a more complete review of this book see Barnett (1987).

From the extensive research now available it is possible to make some predictions of the long term effects of removing or continuing alpine grazing. Much debate still exists around the likely fate of the increased shrubs now present but several authors (Carr and Turner 1959b, Carr 1977, Wimbush and Costin 1979b, Williams 1985) present evidence that if left undisturbed at least some species will decline in the long term as the senescent bushes are replaced by other vegetation. Two authors (Carr 1977 and Williams 1985) discuss this aspect and the paragraphs below summarise some of their conclusions.

The Predicted Effects of Continued Grazing

Some species that are now rare may be eliminated and others may become less common. Erosion will continue in some areas and recovery of damaged mossbeds delayed or prevented. Shrub density (and any associated fire hazard) will gradually increase as the result of continued disturbance and fresh shrub germination, and become as great (if not greater) in the long term than if the grazing was removed earlier. The time for some habitats to return to a climax or near climax condition will be longer, with greater persistence of shrubs. Fewer areas will ultimately be able to return to near their original undisturbed state.

The Predicted Effects of Discontinued Grazing

Now rare or apparently absent plants could appear and increase. Vegetative cover, species diversity, and luxuriance of vegetation will increase and mossbeds will slowly regenerate. Wildflowers will become more numerous. Shrubs will increase in some habitats in the short term as a result of past disturbance, but in the long term (>50 years) at least some shrub species will senesce and be replaced by herbs and grasses. Areas that at this stage have few shrub seedlings present or are in sites climatically unsuited to shrubs will not see this shrub expansion. In the very long term many areas may return to a near original condition.

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VICTORIAN NATIONAL PARKS ASSOCIATION

ACTIVITIES IN THE ALPINE NATIONAL PARK

1. The Association is completely opposed to:
   - cattle grazing
   - timber logging
   - mining of any minerals

   within the proposed Alpine National Park

2. The Association has no objection to:
   - horse tours
   - filmmaking
   - downhill and cross-country skiing
   - bushwalking, caving, canoeing, ice-climbing
   - 4-wheel driving
   - tourists on foot or in their cars

   within the proposed Alpine National Park provided they conform to the management plan being developed for the Park by the Government.

3. The whole concept of the Alpine National Park put forward by the Association is to permit as many people as possible with an interest in the environment, to enjoy the alpine area in as diverse a manner as possible while attempting to restore existing damage and to prevent further damage to the Park.

4. Making money out of the natural resources of the Park while causing damage to that environment does not belong in this philosophy and is thus opposed by the Association.

5. The damage caused by mining, cattle grazing and logging in the proposed Alpine Park is real and obvious, not minor nor illusory.

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POINTLESS DEMONSTRATION BY MOUNTAIN CATTLEMEN

"The protest being organised today by a small group of wealthy film makers and safari tour operators carried about as much value as the patts their cattle dropped all over the high country", said Dick Johnson spokesperson for the Victorian National Parks Association.

"Grazing would be removed from only 0.4% of the Alps should the Alpine National Park Bill be enacted. Demonstrating to the government about the 'Alpine Area - Planning Proposals' is a waste of time since it is government policy that grazing be continued in the vast majority of the Alps."

"It is conservationists, and the Victorian National Parks Association in particular who are campaigning for an Alpine National Park free of the scourge of grazing. We believe that this park is essential to conserve Victoria's precious Alpine region and its associated flora and fauna."

"Thirty years of research on the effects of alpine grazing reveals;

- deterioration of sphagnum bog areas,
- an increase in bare ground,
- serious erosion in some vegetation communities,
- loss of species and diversity,
- changes in vegetation structure,
- an increase in shrubs in some vegetation communities,
- damage to soils,
- reduction in alpine flowers.

This body of research has been entirely consistent in its findings throughout. No research in this 30 year period has proved conflicting results. Such damage is not compatible with conservation and therefore must not be permitted in the proposed Alpine National Park."

"It is only when the scourge of grazing is removed, that the goal of an internationally recognised Alpine National Park of conservation, recreation and economic benefit to Victoria, can be achieved."

Dick Johnson closed with the statement, "That where cattle graze in the high country you will never see Alpine Flowers and you had better be careful where you put your feet!"

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