THE HIGH MOUNTAIN COUNTRY IN THE

KOSCIUSZKO NATIONAL PARK

IN NEW SOUTH WALES

Effects of withdrawal of cattle grazing

and implications for the

ALPINE NATIONAL PARK

in Victoria

A collection of notes and writings by R.W.Condon, rangeland and environmental consultant, on a series of inspections in association with members of the Mountain Cattlemen's Association of Victoria in the late 1980s.in areas of the Kosciuzko National Park and adjoining freehold grazing areas in sub-alpine country.

February, 2007.

Notes on

THE HIGH COUNTRY OF NSW AND VICTORIA

The material between these covers is a collection of writings by Dick Condon, special soil conservationist (in the 1960s) in charge of alpine reclamation works on the Main Range north-east of Mt Kosciuszko. At that time he was also a member of the Kosciuzko State Park Trust representing the Soil Conservation Service of NSW, the Trust having the responsibility of managing the Park

During that time he was also co-chairman (with a senior officer of the Snowy Mountain Hydro-Electric Authority) of the Snowy Mountains Quarterly Soil Conservation Conference. This body's task was to inspect, every three months, a range of current SMHEA engineering and construction works in progress to ensure that they were protected by soil conservation works as necessary, against any risk of erosion which might result in damage to the lands of NSW, and siltation of the dams being constructed by the SMHEA.

Each "conference" involved 2-3 days of field inspections followed by a meeting of the participants in which the erosion situation, and need for erosion control works, was discussed and recorded, and necessary works subsequently put in place by the SMA. The works inspected in this way ranged from dam and other construction project surrounds, borrow pits for dam wall materials, quarries, transmission line tracks, aqueduct and pipeline benches, construction works cut and fill batters, concrete batching plants, tunnel approaches and a host of other types of works. The inspecting party travelled by small bus into some of the most remote regions in the Authority's area of interest.

The conference was especially effective in having the transmission line from the base of the proposed Talbingo Dam to connect with the grid near Yass, re-routed from its planned route up and over the near virgin forested steep slopes and plateau areas of the Warragong Mountains within the Kosciuzko National Park to, instead, follow a route along the gently undulating and already cleared for grazing country along the eastern foreshores of the Blowering Dam above Tumut.

The other important change of plans by the SMHEA was in respect f the Geehi Aqueduct bench which picked up water from creeks draining the western fall of the Main Range beteen the Geehi Dam and the Lady Northcote Canyon on the southern side of Watsons Crags. From the Bella Vista look-out on the road to Geehi Dam, the steep western face of Watson's Crags, much of it steeper than 45 °, the view up the face of Watsons Crags is one of the most awe-inspiring in Australia. The conference was able to convince the Authority that rather than place a great scar across the face of this view, it would be preferable, and probably much cheaper, to run a tunnel through and under Watsons Crags to pick up the water from lady Northcote Canyon

It was Mr. Condon's report to the executive of the Service, and to the then Kosciuzko State Park Trust which formed the basis of the case for the NSW Government to convince the Snowy Mountains Hydro-Electric Authority that it was environmental madness to persist with its proposal to build open aqueducts around the upper western side of Mt Kosciuzko to take

snowmelt water from that side of the mountain, through a tunnel and into the upper reaches of the Snowy River on the eastern side. Although the SMHEA had insisted that this water was essential to its plans for hydro=electric generation, in due course it managed to get the extra water it needed for electricity production by pumping it back up from Jindabyne Dam in off-peak periods and running it through the turbines again in peak periods.

When the National Parks and Wildlife Service was established in 1967, Mr Condon continued as a member of the Local Committee which served the Kosciuszko National Park in an advisory capacity. He was also a foundation member of the National Parks and Wildlife Advisory Council representing the Department of Conservation until his transferto the Western Lands Commission in late 1968. He recalls also that, as a trustee of the then Kosciuszko State Park, it was his task to develop a protocol for necessary soil conservation measures for the developing ski-fields – to ensure the same attention to erosion hazard as was required of the SMHEA in its construction works.

His oversight of research and works programs in the Snowy Mountains was interrupted in 1968 by his transfer to the Western Lands Commission of NSW, retiring as Commissioner. in 1984. He has since had reason to re-visit areas within the Kosciusko National Park and adjoining sub-alpine freehold and leasehold grazing areas, and parts of the Bogong High Plains on behalf of the Mountain Cattlemen's Association of Victoria several times in the late 1980s. This was to review the effects on the environment in the Kosciusko National Park after 30 years of freedom from grazing and to familiarise himself with the Bogong High Plains and other Victorian high country which he had visited earlier in an exchange of visits with officers of the Victorian Soil Conservation Authority.

The "Notes" hereunder, covering a range of matters of relevance to the high country, were developed during those latter visits to the central-eastern areas of the Kosciuzko National Park and the adjoining freehold grazing country. This latter area forms a large bay in the eastern boundary of the Park south-west of Lake Eucumbene, in a region at an elevation of 5,000 to 6,000 feet, but with the vigorous native pastures, with no shortage of wildflowers .This offers a stark contrast to the moribund snowgrass pastures with sparse wildflowers and burgeoning heath overtaking large areas of former snowgrass grassland in the upper catchment of the Geehi, and making its former popular use for bushwalking and cross-country skiing virtually impossible.

The following page provides an outline of the "Contents". Included at the end are extracts from Dick Condon's submission to the Alpine Grazing Tasdk Force Inquiry, submitted thereto in June 2004.

CONTENTS

MC IV

IN BALANCE WITH NATURE

In the beginning,
There was Earth, beautiful and wild;
And then man came to dwell.
At first, he lived like other animals,
Feeding himself on creatures and plants around him.
And this was called IN BALANCE WITH NATURE.
Soon man multiplied.
He grew tired of ceaseless hunting for food;
He built homes and villages.
Wild plants and animals were domesticated.
Some men became Farmers so that others might become Industrialists, Artists or Doctors,
And this was called Society.
Man and Society progressed.
With his God-given ingenuity, man learned to feed, clothe, protect and transport himself more efficiently so he might enjoy Life.
He built cars, houses on top of each other, and nylon.
And life was more enjoyable.
The men called Farmers became efficient.
A single farmer grew food for 28 Industrialists, Artists and Doctors.
And Writers, Engineers, and Teachers as well.
To protect his crops and animals, the Farmer produced substances to repel or destroy Insects, Diseases and Weeds.
These were called Pesticides.
Similar substances were made by Doctors to protect humans.
These were called Medicine.
The Age of Science had arrived and with it came better diet and longer happier lives for more members of Society.
Soon it came to pass,
That certain well-fed members of Society
Disapproved of the Farmer using Science.
They spoke harshly of his techniques for feeding, protecting and preserving plants and animals.
They deplored his upsetting the Balance of Nature.
They longed for the Good Old Days.
And this had emotional appeal to the rest of Society.
By this time Farmers had become so efficient, Society gave them a new title;
Unimportant Minority.
Because Society could not ever imagine a shortage of food,
Laws were passed abolishing Pesticides, Fertilisers, and Food Preservatives.
Insects, Diseases and Weeds flourished.
Crops and animals died.
Food became scarce.
To survive, Industrialists, Artists and Doctors were forced to grow their own food.
They were not very efficient.
People and governments fought wars to gain more agricultural land.
Millions of people were exterminated.
The remaining few lived like animals.
Feeding themselves on creatures and plants around them.
And this was called IN BALANCE WITH NATURE.

Anon.

THE GREENIES

We are the public servants,
A power to behold.
We're here to make the public
Do just as they are told.

We are going to save the mountains;
We will be the mountains' hosts.
If they ever get past Faulkner,
The blighters will be lost.

So they got their beards together,
Laid down their dire plan
Of how to save the mountains;
They would be nature's hand.

First stop all the milling;
Give the cattlemen the boot,
Then let in all the ratbags,
Who everything will shoot.

Yes, let us protect the mountains;
Wipe out all the cattle runs;
Far better wheel ruts, cans and bottles
Than nasty cattle dung.

We will make an Alpine Parkland,
For everyone to use;
The more that come to use it,
The more there'll be abuse.

Let there be protection,
Upon this mountain land,
And if someone should object,
Let's make a solid stand.

And to our politicians go,
Get them the laws to pass;
For no one should stand up to us,
The public servant class.

Now if these mountain people,
Should take us to hand,
It will be very easy,
To make them understand.

We will show them fine examples,
How in the city it is done,
With our beer-can littered gardens;
Our creeks where sewerage runs.

Then there's our polluted beaches;
The finest in the world.
Our smog enshrouded city;
These beauties we'll unfurl.

To the poor misguided people,
Who live on the mountain plains,
And fight their lifelong battle,
To let nature thrive again.

So it's off up to the mountains,
In four wheel drives and cars,
To tear across the plains
And leaving nasty scars

Once there they called a meeting,
And told the mountain men:
We have come to save the mountains,
With our waffle and our pen.

We are here to answer questions;
Ask anything you like;
But please remember, gentlemen,
It is our way that is right.

Asked about protective burning,
Came a mighty howl of "no".
If you do something sensible,
It's off to jail you go.

But surely protective burning,
To help to keep at bay,
The accumulating debris
Was always nature's way.

Fire! O, no, not fire;
It will desecrate,
And help the Alpine foliage
To regenerate.

Well what about the debris
That gathers year by year?
Our valleys are so smothered,
That the creeks you can't get near.

Leave it to ecology;
It's we who know the score.
Soon there'll be a holocaust,
As there has been before.

And when the plains are blackened,
And timber is all dead;
It's on the mountain people,
The blame that we will shed.

For we environmental people,
Of this you must agree,
Could never be to blame,
For we all have a degree.

The meetings are all over;
The struggle now begun,
For men to live with nature,
As mountain men have done.

Let's hope they win their battle;
Stay in their rightful land.
Be allowed to use their knowledge,
In guiding nature's hand.

Wherever people gather,
Let them all declare;
While ever there are mountains,
May the mountain men be there.

—L. J. LAWSON, Sambas Gold Mine,
Harrietville, Vic., 3741.

letter to ON Age 2003?

THE POOR COWS !! CAUGHT AT THE SCENE OF THE CRIME

A RESPONSE TO NOSSAL AND ASHTON -- July 12005.

A s a soil conservationist with plant ecological training and practice in a wide range of difficult environments, including the alpine regions, and as a practicing observer of the alpine scene over several decades, may I comment on some of the points made by Sir Gustav Nossal and David Ashton (*Herald-Sun* 05/07/05 -- p. 20). They will readily appreciate that their contribution is a series on motherhood statements

Firstly; perhaps there is a lot known grazing and park values. But there is much that we, as yet, don't know. To date, park values have been largely based on non-management -- with the consequences we have seen from the 2002-03 bushfires, with large areas burnt under very hot conditions with severe damage to soil stability and to ecological values. This damage would be as much, if not more, than cattle-grazing ever did.

There is no doubt cattle did much damage to park values in earlier times -- when they were in numbers much too great for the country to safely withstand. In the 1895-1902 drought, still regarded as the most severe drought since European settlement, and during many of the severe droughts for the next forty or so years, the alpine and sub-alpine regions served as relief grazing for sheep and cattle from western New South Wales and northern Victoria in addition to the numbers allotted each summer.

That was a period in which unwise land use, and a much drier and windier climate, plus rabbits in their billions, led to widespread severe erosion throughout south-eastern Australia, including the alpine and sub-alpine regions.

There were huge bushfires through alpine areas in Victoria and New South Wales finally brought under control in January 1939. In the Kosiuszko main range area, bogs were still smoukdering 6 weeks after the fire passed through. Nothing can damage bogs and associated valley areas like fire -- leaving these areas looking like burnt-out rabbit warrens, or burning them right out to leave a basin-like structure where the bogs used to be.

After the 2002-03 fires it is not difficult to imagine what these fires, again burning for several weeks, would have done to the bogs -- much worse than the early overuse by cattle could do, in de-stabilising streams and valley floors.

Likewise, it is not difficult to imagine what the 1939 fires, and the 2002-03 fires, would have done to alpine grasslands and heaths, leaving huge areas of steep slopes bare to the inevitable frost-heave processes, with soil particles loosened by needle-ice sliding down hill -- a very difficult environment for plants to get established in.

In February, 1939, these types of problems were compounded by torrential rains, in excessof 300 mm for the month, with similar big rains in May, 1939. Big rains on bare soils left by bushfires would have added greatly to the erosion caused by frost-heave.

When the authorities in New South Wales and Victoria woke up to the situation in the middle 1940s (a situation created largely by two-legged animals), the summer-grazing cattle were caught at the scene of the crime.'

THE 1895-1903 DROUGHT AND SUBSEQUENT DRY IN THE SNOWY MOUNTAINS

An extract from an unknown scientific paper, post-1957, as typed up from a slide of the extract

The analysis by Foley (1957) of droughts in Australia is direct evidence that much of the deterioration was probably initiated about the turn of the century. The drought period of 1895-1903 is stated to have been to have been far worse and more far-reaching in its effects than any before or since. "Never before (1957) has the drought been so extensive. On the previous occasions stock were removed to mountain country to the east but even the mountains have felt the effects of the dry season". The latter part of this remark is significant, since it is generally taken for granted that the mountains never experience drought conditions. Drought is a relative term, and a dry summer in the mountains which is accompanied by an unusually high number of frosts, imposes a severe setback to most of the vegetation. The effect of heavy stocking under these conditions , and the subsequent autumn burning which would have been carried out , would have been still more damaging.

Some idea of the vast numbers of livestock which must have been removed to higher levels during these dry years can be judged from a Narrandera press report during the previous drought **[presumably 1888 – RWC]** It stated that since August, 500,000 sheep had gone through Narrandera towards the mountains and one million sheep were said to have passed through the Wagga district within a month (Foley, 1957). The Narrandera and Wagga route is only one of many leading to the mountains.

The period 1904-10 also continued dry, particularly in southern areas. By 1908. Nimmitabel had reported one of the driest periods on the Monaro for 50 years.

For the 15 years between 1895 and 1910, therefore, the demaand ffor relief grazing on the mountains is likely to have been consistently very heavy.

THE 1900-02 DROUGHT IN THE SNOWY MOUNTAINS AREA.

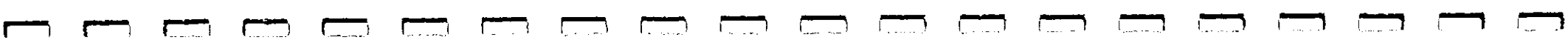
Reference to this drought and the heavy stocking that took place in the mountains as a result thereof is given in Costin et al (1959)* on p.13 as a footnote referring to Foley's (1957) analysis of droughts in Australia which provided indirect evidence that much of the deterioration in the Snowy Mountains area was probably initiated about the turn of the century. (However this does not match McCuckie and Petrie's account in 1927.)

Costin's notes advise "the drought period of 1995-1903 is stated to have been far worse and more far reaching in its effects than any before or since - (to 1959). Foley state that "never before has the drought been so extensive. On previous occasions stock were removed from mountain country to the east but even the mountains have felt the effects of the dry season".

Costin notes that the latter part of this remark is significant, since it is generally taken for granted that the mountains never experience drought conditions. Drought is a relative term, and a dry summer in the mountains, which is accompanied by an unusually number of frosts, imposes a severe set-back to much of the vegetation. The effect of heavy stocking under these conditions, and the subsequent autumn burn which would have been carried out, would have been still more damaging.

Costin goes on - "some idea of the vast numbers of livestock which must have been removed to the higher levels during these dry years can be judged from a Narrandera PRESS report during the previous drought. It stated that since August, 500,000 sheep have gone through Narrandera towards the mountains and one million sheep were said to have passed throughthe Wagga district within a month (Foley 1957). The Narrandera - Wagga route is only one of many leading to the mountains. Costing continues - "the period 1904-1910 also continued dry, particulary in southern areas. By 1908, Nimmitabel reported one of the driest periods on the Monaro for fifty years. For the fifteen years between 1995 -1910, therefore, the demand for relief grazing on the mountains was likely to have consistently very heavy."

* Costin, A.B., Wimbush-D.J., Kerr,D, and Gay, L.W. (1959). - Studies in Catchment Hydrology in the Australian Alps. I Trends in Soils and Vegetations C.S.I.R.O. Div. Pl. Ind. Tech. Paper Number 13 - 1959.



Notes on

THE USE OF FIRE IN HIGH MOUNTAIN COUNTRY BY ABORIGINALS

from discussions with mountain cattlemen Bill Hicks and Jim Commins, both with long expereince in the Victorian high country during a day on the Bogong High Plains in 1987.

He used fire for hunting.

- To push quarry towards an ambush
- to expose animal holes and hides.
- to make it easier to track animals on which the Aboriginal was dependent for food.

Most importantly, he used it to remove tall, dry grass and encourage a fresh green pick so that there would be plenty of animals on the burnt areas next time he came that way.

Under this regime, the countryside was covered with an array of small burns - varying in age from 1 to 10 years or so (and occasionally more) with the result that a wildfire never got very far - and was only extreme over limited areas).

The result of all this, of course, was a diversity of successional stages, each with different species dominant.

A burn would provide an opportunity for those species whose germination depended on fire to crack the seed coat - or provide space and light, or a fresh supply of nutrients, to encourage particular species which might otherwise disappear.

Actually, the worst thing we can do, from the point of view of conserving the natural environment, as distinct from trying to <u>preserve</u> the natural environment, (which is an impossibility anyhow) is to protect a natural area from fire.

If we totally protect an area from fire for long enough we run the risk, or more correctly, we create a certainty, that many of the species will disappear.

That being the case, if we are not prepared to use fire to the extent that the Aboriginals did, or we can't afford to, we should be prepared to think about using something else to replace fire as a means of maintaining the environment in a mere - natural condition.

Some additional points on fire in the high country

Patch burning is ideal for getting patches of heath under control before they take over the whole country side.

It is understood also that the Aborigines used to cook their Bogong Moths by getting a small fire going in patches of dry grass, standing around the edge of the mild flames and placing the grubs over the flame.

Although it might be the ultimate heresy in the current conservation philosophy, the best and most effective tool is the grazing animals, most preferably cattle rather than sheep.

In the montane forest regions, cattle grazing to reduce fuel levels in valley areas can be very effective in reducing the incidence of lightning strike in such areas, and in reducing the intensity of fires developing from lightning ignitions, making them much easier to bring under control before they become in adjoining steep slopes.

Even brumbies can play a role. The fact the brumbies had been using the northern end of the Kiandra Plain in the Kosciuzko National Park was instrumental in making it easier for firefighters to get the 2002-03 fires in that area under control.

HISTORY OF GRAZING IN THE SNOWY MOUNTAINS AREA.

Stanley (1976) gives a detailed outline of the history of grazing and the process of having livestock removed from the Kosciusko National Park in three stages:-

- from the Main Range and Rams Head ~~low~~ Range area in 1944 (because or severe erosion in higher parts of Main Range)
- from all areas above 1,372 m (4,500 feet) - because of the threat of erosion to the SMHEA works)
- from all areas below 1,372 m from 1970 (because of its supposed incompatability with the preservation of natural resources).

There have been a spate of writings on the Snowy Mountains area, all very quick to laud the decision to remove livestock from the alpine and sub-alpine regions. There has also been a great deal of research in the alpine areas, ~~which has been able to show~~ defensibly with the object of proving that the decision was right.

However, looking back with the benefit of hindsight, one can now comment that the first of the above three phases of livestock removal may have been justified as a means of protecting a unique environment, although erosion of more than a minor nature was limited largely to areas above the elevation of 6,400 feet (1,950 m) elevation.

In view of the minimal amount of erosion in areas generally between 4,500 and 6,000 feet, it is reasonable to ask whether this was the real reason for the livestock removal - or was it, as one author (Leitch, 1986) suggested, and which is confirmed in discussions with early SMHEA engineers on the scene at the time, to remove the knowledgeable locals so that they would not be in a position to observe the blunders being made by the Snowy Mountains Authority. In respect of the third phase, the present condition of the natural resources in the KNP, as a result of insistence on preservation, suggests that its integrity as a natural resource is very much at risk.

THE PROHIBITIONS ON GRAZING IN THE MOUNTAINS.

To be able to have the snow lease graziers removed from the mountains, it was necessary to create a climate in the political mind and, as happens so often today, in the mind of the media, so that public opinion could be moulded in the right way, that there was a serious erosion problem in the mountains and that it was caused by sheep and cattle grazing and the cattleman's associated practise of burning the snow grass pastures in the autumn as they took their cattle out of the high country.

Firstly, it has been shown above, that erosion was really serious in only in a very limited section of the Main Range being the three? kilometre strip between Carruthers Peak to the eastern face of Mount Twynam at elevations above 6400 feet - a very steep, very exposed to extremely strong winds and snow and pebble blasting, and extremes of temperature.

In this area, totalling 673 ha it is reasonable to claim that "up to 40% was bare soil". Elsewhere, severe erosion was limited to areas generally less than 0.4 ha. in size, but occasionally up to a hectare, scattered along the crests and sides of the main divide as far north as Bull's Peaks, again at elevations of over 6,000 feet (1812 m). If one were to take an area of 0.4 ha. (1 acre) and put an imaginery fence around it to embrace an area of 1 hectare, it could be claimed that within the area so embraced, "up to 40% of the soil was bare".

In reality, if we take the 517 ha of "areas actually bare" in areas above 6400 feet in the Upper Snowy catchment, add a further 83 ha for severe erosion on the Geehi fall of the Main Range and allow 10% as "actually bare" over the remaining 7500 hectares of the Snowy Mountains above 6000 feet, we have a total of 1350 hectares as "actually bare" in a total area of 10,000 hectares of alpine grassland/ herb field.

This was severe enough to warrant the removal of livestock grazing from the hectares of the Main Range and Rams Head Range area (coinciding fairly closely with the Upper Snowy catchment above Guthega Dam) in 1944. Although it will be shown later that snow lease grazing, as such was not the basic cause of this erosion, livestock grazing was implicated as one of several factors responsible for the severe erosion

it was also reasonable to remove grazing livestock from a unique area of natural environment in which the forces of nature were such as to ensure a wide range of eco-systems at a range of successional stages. It would have made sense,in 1944, to extend the area from which grazing livestock were removed to all areas in excess of 6000 feet elevation.

It is pertinent to recall, at this point, that the Australian Alps are somewhat unusual in that there is soil formation and a cover of soil at elevations up to 7300 feet - the top of Mount Kosciusko. At this elevation, in other alpine areas in the world, there is mostly bare rock, extending skywards for another 5000 or 10,000 feet or, in the case of the Himalayas, another 20,000 feet. In these areas, there is grazing around 6,000 feet but in the floor of deep valleys protected on all sides by high rocky mountains.

Australia's alpine area is therefore rather unusual and it is reasonable to prohibit grazing livestock in areas above 6000 feet.

EROSION ON THE MAIN RANGE.

A clue as to the effect of the 1944-45 drought, and the exceedingly dry year of 1938, on the snowgrass sward on the Main Range is given in Williams and Ashton (1987) referring to Winbush and Costin (1979) who "showed that in the Kosciusko region, grassland severely damaged by droughts in the mid-1960's recovered within 5-10 years provided that the snowgrass litter remained intact.

The paper by Wimbush and Costin should be followed up to find out the basis for their conclusion and the rainfall for Kiandra studied to compare the drought of the middle 1960's with that of 1938 and 1944-45. (Are there rainfall figures for Charlotte's Pass in 1938 and the 1960's).

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SOIL CONSERVATION SERVICE EXPERIMENTAL AREA

- LONG PLAIN via RULES POINT, YARRANGOBILLY.

The Long Plain Experimental Area was established as an enclosure in the early 1950's to study the effects of protecting snowgum grassland in an extensive cold air pool from grazing. It is located on the western side of the Long Plain road (to Brindabella) about 4-5 klms. north of its junction with the Snowy Mtns Highway at Rules Pt. (There are remains of an old hut and diggings nearby and some of the posts are still standing in the area well removed from the road).

It is understood that researchers have enthused over the appearance of new species in the experimental area (check Taylor? and Bryant articles in SCS Jnl).

Rudd (pers. comm.) reports that the appearance of new species may have been more the result of drovers occasionally using the area as a holding paddock for cattle and/or sheep.

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DRYING OF BOGS.

Extracts from B.U.BYLES (1932) Report on the Murray River Catchment,N.S.W.

Page 19. First para. 9th. Line.

"I am told by men who worked on this block (Sn. L. No. 29/57, Ph. of Jagungal) 30 years ago that their first job was to burn and keep on burning the woody shrubs and snow gum: at that time it required a very experienced horse to cross the the swamps, once a horse put its foot off a tussock of grass it would sink up to its belly in the swamp; now in an average summer a bullock dray can be taken across the former swamps and not sink more than a few inches. Last January I rode diagonally across this block, crossing all the main swamps and creeks along the way; in the former swamps, the dry peaty material could be heard crackling under the horse's hooves.

(In some places on this block the snow gum has been completely cleared from the rocky knobs as well as from the basins and lower slopes. (? but would not the basins and lower slopes/have been cold air pools free of timber?)

On this particular block, rocky hills have been cleared where the site is not capable of supporting a continuous cover of grass; as a result, the soil has been laid bare and in many places is blowing away.

Not only on this block, but throughout the Murray Plateau, the country is, on the testimony of men who have mustered cattle there all their lives, definitely drier than it was thirty years ago. * They point out again and again, swamps and creeks which were fo formerly impassable but where a man can ride without any danger of sinking. Consequent upon the drying of the swamps, the creeks are getting lower, and I can foresee the time when some of them will not run through the summer months. ϕ

ϕ See next page

".....it remains to find the cause. It may be due to a climatic cycle but this is not shown by rainfall records in the su rrounding lower country, and there are no rainfall records for the mountain country itself (except for Kiandra -- RWC). One fact is certain,.....there has been a steady diminution in the .....vegetative cover covering on the area, and.....this at least has had a very great effect on the steady drying process.

.....the extreme stage of the drying process have been reached on only a small area; The process is, however, going on all over the high country, and these small areas show how far it will go if allowed to continue unchecked.

The effect etc..... is discussed in later chapters"

Ø But the several years prior to and including 1931 were years of extreme drought in SE Australia, and this would have had some influence in the years preceding the Byles report on the drying up of bogs.

It needs to be appreciated that the long period from 1895 through to 1931 (and beyond to 1945 was a very dry period, averaging a drought every second year over SE Australia, and there were also much stronger winds through this period than before (or since) which would also have had a strong drying influence.. That combination of a drying climate and stronger winds would have had a major influence on the volume of water available in the mountains to keep the bogs in good health. Add to that the very heavy levels of stocking through the drought periods when very large numbers of western stock were brought into the mountains.

These factors would have added up to a triple whammy for of hydrology in the high country.

MORE ABOUT BOGS (AND HEATH)

Bogs.

The fires in 1939 burnt into the bogs and were still burning in the following May (five months later) when the snow fall covered them up. Following these fires there were very heavy rains towards the end of February, (26th and 27th. February,) which would have caused enormous erosion damage on the country denuded of snow grass cover by the very hot fires. Apparently, wherever the fire was intense, the recovery has been with heath rather than snow grass. This didn't happen on the high peaks of the main range north-east of Kosciusko, probably because the elevation, at 6500 feet and above, was too high and too exposed for regeneration to take before the erosion became dominant. presumably because of the poor soil condition which (research suggests) encourages heath

Several photos were taken in Stella Carr's plot of several hectares which, when it was fenced in the early 1950's, was virtuallly all grassland with some patches of heath through it. It is now dense heath almost all over it. There is a boggy creek running down through the middle of the valley, but there are plenty of creeks in grazed country which are in just as good a condition.

A RE-CONSDIERATION OF EROSION IN THE HIGH ALPINE AREAS OF THE MAIN RANGE NORTH-EAST OF MT. KOSIUSZKO

The author has recently had the opportunity to visit the alpine and sub-alpine regions of the Snowy Mountains area (now the Kosciusko National Park under the management of the NSW National Parks and Wildlife Service). He also had reason to visit sub-alpine country of equivalent elevation (up to 6,000 feet - 1812 m) in the Gungarlin River catchment on which grazing has been carried out every summer for 120 years or more.

The observations made on that visit have led to a questioning of the wisdom of destroying the natural values in a national park by protecting large areas from fire and/or grazing, and a questioning of whether the erosion supposed to have been caused by snow-lease grazing was the problem it was said to be in areas between 4,500 feet and 6,000 feet.

This review paper briefly outlines the history of grazing in the Snowy Mountains area, discusses the results of an erosion survey carried out by the Soil Conservation Service in the late 1960's (Bryant, 1973) and sets out the author's own assessment of the erosion problem from his experience in the area during the mid-1960's

It describes the condition of the sub-alpine regions at the present time and makes some unfavourable comparison with the condition of the country on which grazing has been continued since 1958.

the country from which livestock were removed in 1958 is very limited in species composition except in small areas grazed ever since by kangaroos in the former small horse paddock around the former stockmen's huts. By comparison, the long-grazed country carries a wide range of ground species and is able to produce wild flowers in abundance.

As in the remainder of the south-eastern Australian high-, medium-, and low rainfall country, the erosion which may have been present in the pre-1950's era has recovered with the exception of one very exposed site covering about 0.2 hectares.

Cattlemen, and their supposed associated fires, have also been blamed for the destruction of bogs and their drying up throughout the alpine and sub-alpine regions. Recent research in the Victorian Alps suggest that it is not reasonable to blame cattle for degradation and bogs and that there must have been other causes. This subject is reviewed in a separate paper.

One of the principle reasons for undertaking this re-consideration of erosion in the Snowy Mountains area has been to show up the blatant mis-representation that has taken place over the years on this subject. This mis-representation reached its zenith in an article in the Winter, 1987 issue of the CSIRO environmental magazine "Ecos" wherein it was stated, on two occasions, that "up to 40% of the sub-alpine grassland had become bare" when livestock were banned from the NSW high country in 1958. ~~(See footnote page~~ (See footnote at end). 9

This is a most impressive statement for those who have been long conditioned to believing that sheep and cattle have been responsible for widespread erosion in the Snowy Mountains areas. However it is absolutely meaningless unless one puts a frame around it. This article does put a frame around this figure and shows that it refers only to a small area of extremely vulnerable and exposed sites on the Main Range between Carruthers Peak and Mount Twynam at elevations in excess of 6400 feet. The review also considers other factors which may have been responsible for this serious erosion other than cattle and sheep grazing.

EROSION IN THE UPPER SNOWY CATCHMENT.

In the late 1960's, the Soil Conservation Service carried out a survey (see Bryant, 1973) of the Snowy River catchment area above Lake Jindabyne embracing the area from the head of the Eucumbene River just north of Kiandra southwards to the Thredbro and Little Rivers running close to the Alpine Way between Dead Horse Gap and Jindabyne.

This area is predominantly alpine and sub-alpine (generally above 1372 m - 4,500 feet) with some extensive areas of forest country in the steep mountain valleys along the eastern side.

Taylor (1958) in his erosion survey of the whole Snowy catchment in NSW reports 72 square miles (17,800 ha) of alpine country.

Morland (1958) in his erosion survey of the Hume catchment area reports 20 square miles (5,180 ha) of alpine country in the Hume catchment between Dead Horse Gap and Mount Twynum making a total of 23,000 ha of alpine country. There are a further approximately 1,000 ha of country above 6,000 feet in small areas in the Brassy Mountains area on the divide between the Snowy and the Hume and Tumut catchments.

The majority of the severe and moderate erosion in the area above 6,000 feet comprising the alpine regions is confined primarily to the Main Range with scattered areas along the Main Divide as far north as Bells Peaks at the head of the Gungarlin River Catchment.

The author was involved in directing the Soil Conservation Service summit area works programme in the Carruthers Peak and Mount Twynam areas for several years and knew the area in detail. He estimates that at least 90% of the moderate and the severe erosion in the Snowy River Catchment above Guthega Dam would be in the zone above 6,400 feet. This is confirmed by examination of the map in Bryant (1973) in relation to the 6,400 foot contour.

Bryant (1973) has published the results of the erosion survey for the Upper Snowy catchment comprising 8,955 ha above Guthega Dam. He has set out four* sheet erosion classes as follows:-

S0 Neglible sheet erosion - in which 10% of the landscape might be bare with a soil loss to 7.5 cms - 5568 ha.

S1 Slight sheet erosion - in which 25% of the landscape would be bare with soil loss in these areas from 7 - 15 cms - ~~to~~ 674 ha.

S2 Moderate sheet erosion - in which 26-75% of the landscape would be bare with soil loss to 15-22.5 cms - 314 ha.

S3 Severe sheet erosion - in which 100% of the landscape is bare with soil loss to 30 cms or more - 85 ha.

Bryant's table ~~will~~ also show the areas treated by soil conservation works which would have previously been severe erosion and totalling 48 ha.

The above values for the various classes of erosion (taken from Table I in Bryant, 1973) can be converted to areas actually bare to give a reasonably accurate estimate of the extent of erosion over the whole catchment. This has been done in Table I below by using the percentage values in column 3 as multipliers of the values in column 2 to get areas actually bare in each category in column 4. (Table not available)

When the areas of the four sheet erosion classes are converted to "areas actually bare" the total area bare is 1505 ha, representing 16.8% of the catchment. However, 567 ha (representing 6.2% of the total catchment, are in small areas representing less than 10% of the landscape so mapped and would not contribute to any extent to the runoff and soil loss into streamlets. This leaves 10.6% of the total area for catchment as moderately and severely effected by erosion. A further 3% of the area is comprised of bare areas in snow patch screes and fjeldmark stone pavements.

Thus, 10.7% of the catchment area above Guthega Dam would have been in a bare and eroding condition. However, this erosion was not distributed uniformly over the catchment. Bryant's Table III shows the majority of the moderate

* Bryant's Table III, showing the distribution of erosion classes in sub-catchments, includes a "severe" class which is not included in his Table II from which the description of the preceding three classes is drawn.

(1) Footnote. In considering the whole question of grazing and its supposed effects on erosion in alpine and sub-alpine areas, reference is made to the article "A Prescription for Kosciusko" in the winter, 1987 issue of "Ecos", a CSIRO review magazine on environmental subjects. In two places in this article it is mentioned that "livestock were banned from the NSW high country in 1958 - when up to 40% of the sub-alpine grass-land had become bare soil" and,in another place "levels of 40% or more (of bare ground) were common when grazing leases were withdrawn."

To be able to get such a figure, one has to go to the most severely and extensively eroded area in the whole Snowy Mountains region, to a site more exposed to extremes of climate than any other site on mainland Australia (4.5 months under snow, 3-4 months of nightly freeze-thaw effects in autumn and spring, high winds and snow and pebble blasting on the crests of the ridges, deep snow drifts on steepishly facing aspects almost right through the summer in most years, etc etc. One could get a higher figure still by going to 6,800 feet. No where else in the Snowy Mountains region, including all other areas above 6,400 feet, could one say that there "up to 40% bare." One could exceed this figure occasionally by placing a one hectare quadrat over a severely eroded area on Gungardin or the Brassy Mountains.

If this is the level of honesty in reporting in a very responsible journal, one has to wonder to what extent the remaining material in the same article is credible.

THE PRESENT STATUS OF THE HIGH MOUNTAIN COUNTRY

By Dick Condon, rangeland and
environmental consultant
1989 ?

The following notes were written following a visit to the Victorian high country with Mr. Jim Commins, then recently retired as President of the Mountain Cattlemen's Association of Victoria, discussing various matters raised for discussion on that occasion.

They discuss the causes of erosion in the wayback times when there was apparently little control over stock numbers going into the mountains, particularly in respect of the NSW high country. It can be readily appreciated that much of the erosion damage was done in those early time. But stock numers have been reduced very substantially

There is also discussion of the adverse effects of continuous light grazing, and the adverse effects of continuous no-grazing and non-burning. and the likelihood of extreme fires as a consequence f non-grazing.

It also gives an introduction to management considerations which have been discussed elsewhere in these papers.

A copy of these notes would have beenm provided to Mr Commins.

THE PRESENT STATUS OF THE VICTORIAN HIGH MOUNTAIN COUNTRY.

Australia's sub-alpine rangelands have been through periods of intensive grazing pressure during the summer months in early/~~times~~historic. This was particularly so in drought years before land administration authorities began to exercise some control over the use of these lands. When there were severe droughts in the country further inland, the mountain grazing land became a refuge for stock as far as the western Riverina.

This was the case in the NSW section of the Alpine lands and much of the severe erosion visible in the Kosciusko and Main Range summit area probably dates from this time. Additionally, four major stock routes criss crossed over Mount Twynam, adding to the grazing and trampling pressures and considerably extending the bare areas created by the snow drifts which lay in east-facing steep slopes through much of the summer.

There is doubt as to whether the Victorian high country experienced the same grazing pressures as those in NSW. Land users of long experiences explained that it was extremely difficult to drove sheep into the Victorian mountain country and they needed shepherding to protect them from wild dogs. ~~Cattle in the mountains responded to drought by dying because of the lack of "guts" in the dry snow grass foliage~~.

Another principal cause of erosion in earlier times was undoubtedly rabbits in plague proportions from the 1890's. Their effects have largely been ignored in the debate around livestock grazing, although recent research by CSIRO (ECOS, Winter 1987) has again drawn attention to the damage they can do.

Rabbits persisted in plague proportions to 1950 and the outbreak of myxomatosis, adding greatly to the grazing pressures and exacerbating the effects of drought. The mountain ranges were not spared from this plague. Much of the damage attributed to livestock can be blamed on the rabbit.

Under these intensive grazing pressures the pastures on the more vulnerable sites degenerated, erosion was initiated under the harsh freeze-thaw conditions prevailing in spring and autumn so that bare areas, even on slight slopes, could only increase in area.

With greater control over land use and regulation of use by the authorities, and the removal of livestock from more severely eroded areas, there has been substantial recovery on many of the eroded sites on the gentler slopes. Recovery has been slow or non-existent on more difficult sites, the degree of difficulty increasing with increasing slope and altitude.

There would seem to be no doubt about the wisdom of taking cattle out of the country over 6,000 feet (1820 M), the climate and soil conditions at these elevations making it too easy to extend the natural erosion (feldjmark) which was common on exposed sites.

Whether it has been a wise move to take them out of the lower country (down to 4,500 feet - 1360 M) in NSW snow lease grazing country in 1957 and eventually over the whole of the (now) Kosciusko National Park area in the early 1970's, only time will tell. There are indications that the lack of wild fire (as a natural feature of the environment prior to European settlement) and livestock grazing have led to such an enormous build up of rubbish (leaves and bark litter, shrubs and tall grass) on the forest floor environment that flows into the storages of the Snowy Mountains Scheme have been seriously reduced, springs that ran unfailingly since the areas were first settled have dried up. (This is a parallel of what has happened since the 1950's in western NSW where the more tall, prolific growth, especially over formerly severely eroded areas, has virtually eliminated the flow from once reliable catchments. The same kind of thing has happened over the western slopes and tablelands of NSW. Here the extra cover provided by the trinity of super, sub (clover) and myxo has so reduced runoff that 80% of the gullies which dissected virtually every drainage line in the pre-1950 area are now

stable and landholders have difficulty in maintaining stock water supplies for the larger number of livestock that they can now carry.)

With the present build up of excessive vegetative material in the forest and grassland environment of the high mountain country, it merely needs another January 1939 fire and most of the Kosciusko National Park could be a blackened mass. Heavy rains in the wake of such a fire will cause enormous damage insiltation of the storages depended on the mountain catchment areas and their storage life will be shortened by decades.

It has long been considered bv researchers and administrators that the only way to bring about recovery and protect such fragile environments from erosion was to keep stock out altogether - to allow the native plants to grow unchecked by grazing.

This is true in respect of continuous grazing, but experience in other countries has revealed that short duration/high density grazing followed by sufficient rest to allow the plants to recover and re-establish root reserves, is more effective in restoring degraded land than total de-stocking or continuous light grazing. Why this is so is best considered in the light of understanding of the deleterious effects of continuous light grazing and continuous non-grazing, of non-burning, and the efect of these "non"-practices in promoting vulnerability to extreme fire.

The Deleterious Effects of Continuous Light Grazing.

In discussing these effects, it is necessary to be more specific as to what the term "continuous light grazing" implies. In the context of the year-long or, in the case of the sub-alpine woodlands, season-long stocking which is the general approach to the management of our native pasture lands, continuous grazing is, in effect, long duration/low density grazing - as distinct from other approaches to pasture management such as short duration/high density grazing (such as might be used by "uneducated" shepherds and the more sophiscated pasture managers in the modern rural scene).

It needs to be acknowledged at this point that continuous grazing at high stocking levels (or long duration/high density stocking) has undesirable effects which do not need to be spelt out. However, continuous grazing under the normal stocking rates which apply to native grasslands, although less damaging than long term heavy stocking, also has several undesirable effects:-

(1) the more palatable species are severely over-grazed, being cropped and re-cropped with no chance of replacing root reserves unless total forage production is very prolific as a result of continuing good rains. Under such treatment, the palatable perennial plants weaken and die. If the chronic over-grazing prevents those species from flowering and seeding, their prospects of being replaced by free-seeding vigorous annuals or weed species, or unpalatable perennials, are very bright.

(2) The less palatable species are grazed only lightly, allowing better opportunities for flowering and seeding and hence replacement of the more palatable species weakened by over-grazing.

(3) The unpalatable species, being rarely grazed, are able to flower and seed and go through their life cycle without hindrance, allowing even better opportunities for replacing weakened perennial species.

(4) There is a further adverse affect arising out of this discrimination in favour of unpalatable species. If the latter are perennial, the individual plants will get larger and larger, occupying increasing space below ground and above and providing increasing competition for light, plant nutrients and moisture so that other species have difficulty in gaining a foothold.

The pasture not only declines in quality and productivity for livestock

but also suffer from a lack of diversity with other species only getting an opportunity to re-invade in very favourable conditions which, of course, also favour the well established undesirables. If there is a fortuitious occurrence of fire, this might provide an opportunity for the sub-dominant species, but might also favour the undesirables).

Under these conditions in the sub-alpine and alpine grassland environment, the snow grass has become a tight monospecific sward into which other species have little prospect of establishing. Hence the almost total lack of the herbaceous species which would provide the necessary diversity and the floral aesthetics which is an integral aspect of such diversity.

A further adverse effect which is not generally recognised is the slow recycling of nutrients in such a situation. In the grassland environment the foliage which dries at the end of the growing season remains standing for several years. As more growth appears from the base of the plants, the old leaf and stem material might fall but is not able to reach the soil surface because of the tight sward and has to decompose in the air, the plant nutrients only slowly returning to the soil as a result of leaching by the action of falling rain, mist or snow melt.

The Deleterious Effects of Continuous Non-Stocking and Non-burning.

The same influences apply in the totally unstocked situation, such as applies in a National Park. The dense snow grass sward which developed under the long duration/low density grazing regime is slow to change when stock are eliminated completely from the environment.

In the pre-European environment fire, as escape from or part of deliberate acts of Aboriginal burning, provided the means for removing the dead and dying foliage, allowing the minerals to return to the soil in a flush and providing the opportunity for the species choked out by the dense grass sward to establish in the opened up sward or the tussock cover and utilise the flush of newly released minerals in the ashes.

In such a way is the seed store in the soil replenished. If a grassland sward is protected from fire for too long, the seed store in the decomposing organic matter and the upper soil layer will gradually lose its viability as the seeds themselves rot and become part of the organic soil horizon.

Fire would also have been an influence, although possibly less frequent, in the pre-Aboriginal era, as lightning fires combined with regular occasional (as in 1 in 5 - 10 years) tinder dry conditions to burn the excess foliage material and re-invigorate the herbage component of the grassland.

In the modern European human environment, fire has been judged as being harmful to the point where deliberate burning is not permitted and enormous effort is made to put out naturally occurring fires, so that their influence for environmental good is minimised. Only on the areas burnt, in spite of our best efforts, do we have anything remotely approaching the pre-European natural condition.

However, these fires are often of such a nature, occurring under conditions of a hot, dry summer when the grass is dried out, and the forest lands are tinder-dry, that the environmental damage is extreme.

Extreme Fires as a Consequence of Non-Grazing.

In the treeless grassland area, fires under extreme conditions burn out the crowns of the grass, leaving it severely weakened, and allow the fire to carry on to the bogs in the valley floor. If the bogs are dried out, they are particularly prone to fire damage, the fire getting into the peat and burning for several days, killing the sphagnum and other bog plants. The result is like a huge sponge with little water holding capacity and likely to collapse when the first flow comes through.

In timbered and forested areas, fire under extreme conditions consumes not only the leaf and bark litter on the forest floor but the decomposing organic matter down into the soil surface, leaving a fine ashy surface ready to blow away in a slight breeze. Soils in such condition are prone to large losses if the initial rains after the fire are of high intensity.

The most vulnerable areas in the forest environment under extreme fire conditions are the stream banks, with the lining of thick tea-tree under the shrubs which provide a dense protective barrier which will flex with the force of flood flows and hold much of the silt which may be carried in such flows.

Under normal conditions the stream banks and verges are wet or damp and the grass greener than on the slopes so that fire under such conditions rarely gets to the tea-tree. However, if fire gets into the bank fringing tea-tree when conditions are dry, the tea-tree is extremely flammable and is reduced to ashes and a few small faggots at the base which may also burn well into the soil. The consequence for the stream environment is truly catastrophic, even under normal bank full conditions.

The huge forest resource of the mountain country of Victoria also becomes vulnerable to widespread severe damage under extreme conditions such as occurred in the summer of 1982 which, the record shows, are likely to be repeated every ten or eleven years. In addition to the extreme damage to the forest floor environment, the timber resource itself is severely damaged under crown fire conditions, epicormic branching following the fire discounting the future timber value, and leaving the trees prone to timber-destroying diseases and insect attack.

The Victorian(and NSW) Government spends millions of dollars annually in providing and maintaining fire trails which are virtually useless under extreme fire conditions and can only be used for access and as back burning lines when conditions amelerioratе considerably.

Much more effective control of wild fires can be attained by allowing grazing in the forest valley areas such that each valley becomes a fire brake, as the grass fuel is kept down to a reasonable level towards the end of the fire season. In the event of wild fire, the intensity of fire on the valley floor will be mild and slow moving, the flame height insufficient to dry out the tea-tree and other scrub foliage on the stream bank. The tea-tree may be scorched but will still fulfill its role of bank protection.

Slow moving fire in the valley area will provide an opportunity for fire fighting forces to effect control in the easier access conditions of valley floors, will provide time to establish downhill and upwind backward burns from established fire trails off the ridge tops.

Apart from the production of foodstuffs and the addition to the common wealth (two words) the government could save the taxpaying community many millions of dollars spent needlessly in attempting to put out wildfires under extreme conditions and protect the forest resource from the many more millions of dollars of damage caused by extreme wildfires.

Forest and mountain grazing will not prevent ignition under extreme conditions, but will reduce ignitions and limit the number and extent of earlier ignitions which are the real problem on a blow up day.

Must we flagellate our forest resources with fire for the sake of mollifying an uninformed and noisy and often untruthful minority of activists.

Cattle grazing in the forest will also place an additional field and mountain-wise labour resource in the mountain regions.

Management considerations

Our native alpine and sub-alpine grasslands and forest grassy floors, are being debilitated under the supposedly benign management influences which have insisted on long duration/low density stocking or no grazing at all, and protection from fires. Only in supposedly degraded areas do the non-grasses have an opportunity to establish and endeavour to restore some measure of diversity to the vegetative environment.

The management of our native grasslands, as well as improved pasture lands, needs to be approaced in a more intelligent manner than applies at present, and to be based on a proper understanding of the role of animals and fire in maintaining a healthy diverse sward, whether for pastoral purposes or conservation values.

The following discussion ϕ on the application of rational grazing techniques and holistic resource management, sets out an approach whereby we might make a conscious effort to intelligently manage the physical and biological resource which makes up our mountain catchment, forest and grazing lands.

ϕ no following discsn.

STUDIES IN EROSION IN ALPINE AREAS.

I. WIND EFFECTS ON SNOW-KILLED SNOWGRASS.

In January, 1988, the opportunity was taken to inspect areas around the summit of Mt. Twynam (m) the third highest eminence in the Australian Alps after Mt. Kosciusko (m) and Mt. Townsend (m). Mt. Twynam lies km north-easterly of Mt. Kosciusko, the summit being a rounded mass of jumbled granite boulders, mostly small and rounded, separated by stretches of dense snowgrass Poa aespitosa) with occasional patches of snow daisy (Calmisia) and a scattering of other alpine flowers such as purple eyebrights ((Euphrasia) white everlasting daisies ( ) and others.

The south-western face of the summit of Mt. Twynam has been severely eroded in the distant past with about one hectare of topsoil stripped away to expose a myriad of small boulders (See Fig.). This area lies just east of the junction with the slates and phyllites on the long whaleback ridge which forms the line of peaks comprising Mt. Northcote, Mt. Lee and Carruthers Peak and the steep-sided inter-connecting ridges.

At the junction of the slates/phyllites and the granite of Mt. Twynam, there is a steep south-trending valley running down to the large flat fen and valley bog areas from which the valley falls almost vertically into Blue Lake. The rounded upper slopes of the valley above the fen carries a snowdrift well into January in most years as does the long east facing slope of the ridge running southerly before swinging south-westerly to Carruthers Peak. This is probably the longest (in length and time) of all snow drifts in the alpine region. The upper edge of the snowdrift scree is a deep stone pavement or fjaeldmark with the usual range of ground-hugging species.

The site of the long snow-drift, and the configuration of the Main Range running back to the rounded peak of Kosciusko and the jagged top of Mt. Townsend is shown in Fig. .

To what extent the stone pavement is due to natural erosion in the very exposed site which would be also under snow well into the summer ~~and~~ or accelerated erosion is not known but the western (upper) edge has been gradually working up cliffs by undermining the snowgrass sward.

There are similar fjaeldmark communities on stone pavements on the crests of the steepsided ridges between Mrs. Northcote and Lee and Carruthers Peak and scattered smaller such areas on the gentler western slopes of the long ridge falling down to the Upper Blue Lake Creek. These surfaces are very exposed to extremely high velocity winds with consequent snow blasting and gravel blasting, the winds being able to move pebbles up to 5 mm diameter in small windfunnel areas (See Fig.).

As a consequence these stone pavement areas are extending slowly downwind. The largest of the ground hugging fjaeldmark plants, Epacris pertrophila grows downwind into the pebbles and soil accumulating on that side and dies on the upwind side as a consequence of snow blasting (and presumably old age. The components of the fjaeldmark communities are described in detail by Costin (1948) and Bryant (1971).

The area on the western face of Mt. Twynam and the adjoining south-west trending ridge, ~~is the most severely eroded area~~ along with the eroded slopes of Carruthers Peak, ~~are~~ are the most severely eroded areas in the alpine zone (generally above 1800 m). Previous authors (Costin) Taylor (1958), Bryant ( ) have attributed the severe erosion to long periods of summer grazing by sheep and cattle under the snow-lease grazing regime which operated until 1944 when the then NSW Govt. was persuaded to prohibit snowlease grazing in the Upper Snowy Valley and surrounding ranges generally above the present site of Guthega Dam.

Cattle and sheep have also been blamed, having been caught at the scene of the crime, for having destroyed all the bogs in the country generally over 1800 m, and for causing the disappearance of many herbaceous species. However there is much evidence now coming to light that cattle do not inhabit bogs to the extent previously claimed, that judicious grazing by cattle is on a much more effective means of ensuring diversity of species in a "natural" environment than total protection from fire and grazing, and that there were other factors than cattle and sheep grazing responsible for initiating and extending erosion in areas above 1800 m.

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Examination of old aerial photographs shows quite conclusively that 90% of sheet erosion occupying more areas greater than 5 metres square occurs in the 10% of the alpine and sub-alpine regions above 1800 m. This is discussed in detail in Condon(~~submitted for publication~~).

MACV /KNP - 1/88.

SEVERE EROSION ON STEEP SLOPES

ON MURRUMBIDGEE FRONTAGE BELOW TANTANGARA WALL.

Notes on inspection 20-1-88 and
discussions with John Rudd.

Inspection of aerial photos shows an extensive area affected by sheet erosion along the steep north-facing and sometimes west-facing slopes where the river, flowing generally north-easterly, passes through the deep gap in the Tantangara Range in which the Tantangara Dam has been placed. There are occasional small eroded areas on east-facing slopes although mostly smaller, these areas fall 50-100 metres down the slope and may be from 50-100 m wide across the slope, in one site extending for about 1 km along the frontage although reducing to 10-20 m at the NE end. The largest areas are within 2 km of the dam wall where the river takes a very flattened but very pronounced S bend. Slopes on severely eroded areas are of the order of 20-30%.

The eroded areas occur within the treeless grassland in the area known as "The Gulf" and occur scattered over several kms of river frontage until the river begins to take a south-easterly course through the Tallgeh Hills below its junction with Patton's Creek coming in from the north near Peden's Hut.

Away from the steep falls of 20-30% slope into the view, the treeless grassland country, generally 1-2 kms wide along the south-east bank of the river; is gently undulating and undulating at 10-20% slopes.

The phenomenon was first noticed during the October, 1987 Kosciusko inspection at the point where the track over the hills from Yuouk comes out of the forested country on to the flats near Peden's Hut. Photographs were taken at this point and, in January, 1988 on the 3rd such area immediately below the dam wall.

The areas affected by erosion are derived from shale which breaks up into flat yellow-brown stones to 5-10 cms dimensions and 1-2 cms thick down to small chips of 1-3 cm dimensions and 3-5 mms thick. This material now forms a stone pavement so that the process of soil loss has been slowed down.

Although not inspected along the top edges it is presumed that the eroded edges are slowly working their way up into the un-eroded pasture. In one place where the river takes a very sharp J bend erosion working up the steep slopes of the point so formed has coalesced over the top of the ridge.

The areas near the dam wall are being colonized very slowly by a prostrate perennial pea with yellow and red flowers and dense fine foliage with finely undulate leaves to a height of 5-7 cms and up to 2 m diameter. Areas covered by this plant have ideal rich soil conditions underneath. Cover by this plant and occasional plants of other species provides about 5-10% cover over the upper and middle parts of the affected areas.

Recovery is taking place from the bottom up as soil being washed down from the slope above has been caught in the vegetation at the edge of the eroded area and has been colonised by the normal native grasses and herbs working up the slope into the accumulating soil material and has made its way about 1/3rd to 1/4 of the way up the slope.

In the 8 sq. kms of grassland including small areas of woodland in the 1½ - 2km wide strip between steep forested hills there are about 8 ha of bare eroded surfaces counting all the small areas visible on the airphoto, - representing about 10% of th grassland/woodland landscape.

CAUSES OF EROSION.

It is easy to blame cattle and sheep grazing as the cause of this impressive but somewhat limited area of severe erosion and not look any further. Cattle and sheep must be implicated because they were there, but in view of the general lack of erosion throughout the Murrumbidgee catchment it is unreasonable not to look for other factors which made the sites more vulnerable to erosion than elsewhere. Several factors may be listed.

1. Steep Slopes.

This is certainly a factor, slopes being such that once erosion was triggered by some other factor, or factors, it would readily extend in area upslope and downslope.

2. Erodibility of Soils.

The steep slopes and ridge top sites would have ensured shallow stony and gravelly soils, these characteristics being accentuated by the northerly and westerly aspects of most of the eroded areas. (See under item 4 for the factors involved).

3. Grazing and trampling pressures.

At this stage it is not known whether the gap through the mountain was a frequently used route for stock coming into the mountains for snow lease grazing and moving out at the end of the season. It certainly would be for stock on snow leases to the west of the steep ranges to the north and south of the gap.

There was a regular stock route which left the Murrumbidgee valley at the point where it is joined by Patton's Creek and heads over the forested range towards Yauok and Adaminaby. Stock moving from the gap to pick up this stock route would have had to fan out over the north-facing slopes to get to the easy-travelling grassland along the south-east frontage to the river.

It would be expected that the north - west facing slopes would have been popular camping spots for sheep and cattle, being drier and warmer and close to water. Likewise the step east-facing slopes would have provided excellent shelter from cold westerlies especially on sunny mornings.

Contrary to this expectation, a person who had spent a lot of time in the area in the Snow-lease Grazing era claims that in all the years that he had travelled through the gap he had never seen cattle on the eroded areas. - presumably because they had been forced out (see under item 8 below).

It has been pointed out that the areas along the south bank of the Murrumbidgee near its junction with Patton's Creek were on the corner of a grazing lease which was otherwise all forest, the steep treeless slopes immediately above the river being the only open country on that particular lease and therefore subjected to much higher grazing and trampling pressures as stock came down to water and camp on the shallow soils of the warm north-facing slopes.

It has also been pointed out that a travelling stock route left the gently undulating plain country at this point heading over the forested mountain range towards Yauok.

4. Hot and dry aspect.

Throughout the mountain forests and sub-alpine grasslands and woodlands the westerly through to northerly aspects are ecologically poorer sites than elsewhere, because they are drier and the soils shallow and stony with consequent poor growth of trees in forest and woodland areas and sparse grass cover in grassland areas. This factor also would have made them more comfortable camp sites for stock. The shallow soils would be more vulnerable to grazing pressures and the trampling pressures associated with stock camping areas.

5. High Wind Velocities.

The steep sided gap at the site of dam wall would have concentrated air-flow from the normally stronger winds with a westerly component, creating a very pronounced wind-funnel effect which would have caused much greater wind velocities for a few hundred metres downwind from the Gap.

Strong winds would have had a major influence in deepening and extending any bare areas initiated by other factors. Having observed the effect of a sixty knot wind on a one-hectare eroded ridge top in the Omeo district in the Victorian mountains in completely blotting out visibility on a nearby road it is not difficult to imagine the dust-pall emanating from any eroded area immediately downwind of the Gap.

6. Frost-heave effects.

Undoubtedly a major factor in inhibiting recovery is the de-stabilizing influence of frost-heave in a large cold-air pool in which cold air would bank up on the western side of the gap and begin flowing through a and spreading over the widening flat valley to the east. It is expected that freezing temperatures experienced each evening in autumn, winter would keep soils bared by otherfactors in a continually active and pulverised state by the frost-heaving effect of the needle-ice. This lifts the surface soil off the ground, the small clods being broken up into granules as they are laid back on the surface after the needle-ice melts each day.

If there is any slope, as there is here, bare areas extend rapidly — upslope, downslope and sideways.

References.

CLOTHIER, D.P. and CONDON, R.W. (1969a). Soil Conservation in Alpine catchments. Jnl. Soil Cons. N.S.W. 24:2:(96).

CLOTHIER, D.P. and CONDON, R.W. (1969b). Bitumen straw mulching for batter stabilization on the Kosciusko Road. Jnl. Soil Cons. N.S.W. 24:4:(218).

7. Rabbits.

Rabbits always had a strong presence in this area before myxematosis and there is evidence of rabbits there now in shallow burrows and plentiful rabbit scrapes. It is reported that the area around Peden's Hut on the gentle slopes north of the junction of Paton's Creek with the Murrumbidgee River was in the same condition as the subject areas in the period when rabbits were bad before the advent of myxomatosis. There is no sign now of any erosion in the vicinity of Peden's Hut ~~the~~ the steep areas on the Murrumbidgee are recovering slowly but all have a long way to go.

8. Environmental conditions.

The high winds and frost heave effects would have ensured environmental conditions on the steep frontage slopes to make recovery much more difficult ~~in respect of recovery~~ and near impossible. It can be expected that the same environmental conditions have also contributed to their greater vulnerability.

Prior to the N.P.W.S. taking over cotrol of the Kosciusko N.P. in 1968, the subject area had been fenced off by the then lessees as early as 1940 presumably in an endeavour to encourage recovery. The eroded areas near the Gap have therefore been protected from livestock grazing for the last 50 years but this has had little effect in encouraging recovery. This also suggests more difficult environmental conditions on the steep north- and west-facing slopes which would be hotter and drier than other aspects. The steep slopes also increase vulnerability and make conditions more difficult for recovery.

That there is something different and more difficult about these sites is shown by a comparison with the area around Peden's Hut. Rudd (pers. comm.) reports that until rabbits largely disappeared because of myxomatosis in the early 1950's, the area around Peden's Hut, about 0.5 kms to the north of severely eroded steep frontage country, was in the same condition as the eroded areas on the steep frontage country. Since the rabbits disappeared the area around Peden's Hut has become densely grassed over and, from casual observation, there is no indication that the area was ever eroded. WEEDS

The slopes around Peden's Hut are much gentler (around 10%) and the soils are deep sandy and gritty loams derived from granite [or are they - check wombat hole photo?] The shallow shaley gravelly soils on the steeper frontage slopes may be more susceptible to erosion, and certainly more adverse to recovery.

RWC

RECLAMATION TECHNIQUES.

There has been some colonization of the eroded areas by a densely foliaged prostrate pea-type plant to about 1-5% of the eroded areas. Other prostrate plants are present.

Recovery is also taking place from the foot of the slopes (see photos ——— & ———) with grasses and herbs and a scattering of the heather bush (red-berried plant with upright habit to 1½ metres and small green leaves 1 cm x 0.2 cms).

The recovery has worked progressively up the steep slope as soil dislodged from bare areas by frost-heave has been caught in the grass and herbage on the adjoining non-eroded area "banking" by accumulation upslope and being progressively occupied by the grass and herbage working up from below.

The standard reclamation technique for large areas of severe sheet erosion in areas where frost-heave makes conditions difficult for germinating seedlings is to cultivate lightly, spread seed and fertilizer lay a mulch of straw or other material to insulate the surface and tie the mulch down with netting or bitumen to prevent it being blown away in the wind.

Where access is possible for wheeled vehicles, the best technique is to mix up the seed, fertilizer and fine cellulose-fibre mulch in a large tanker of water and to spray this on with a fire hose. This was the technique used very successfully in the stabilisation of steep batters on the Kosciusko road. (Ibid 1969)
Costs in the late 1960's were
(see Condon & Clothier)

This was the technique used on the reclamation of eroded areas on Mt. Twynam and Carruthers Peak section of the Main Range in the 1960's (Condon & Clothier 1969a). In the 1960's cost was of the order of 50c. per square metre would be $2 to $3 per sq. m now.

For the areas in question below the Tantangara dam wall it would not be impossible to get a heavy 4WD tanker up the 20% shlpes or on to the ridge tops above steeper slopes and spray the eroded surfaces with the seed fertilizer and mulch material.

However, the cheapest and most effective way of reclaiming these areas to the point where the native species can survive successfully would be fence them, separately if necessary and leave a mob of cattle in each "paddock" so created for 2 to 3 days until the earth was thoroughly cultivated, to sow the cultivated area with grasses and clovers and fertilizers. Should it rain enough to wet the soil to 8-10 cms the cattle can be brought back while the soil is near wet so that their hoofmarks will make thousands of indentations which will hold water, and soil and germinating seedlings which may be dislodged by frost-heave. Presumably the best time to do this would be early November as the weather begins to warm up and the risk of frost-heave effect is lessened.

When the resultant cover is 30 cms high and the species which are required as dominants in the eventual community are seeding the cattle can be brought back to graze, trample, defaecate and ureinate for a few hours before being moved on to the next such area. This should be done when there is still enough warmth in the weather to produce enough growth to provide cover during the difficult periods before and after snow cover.

In subsequent years such treatment could be carried out each year after the main seeding has taken place. To ensure a rapid restoration to local native species the original seed mixture should include snow grass and herbaceous species which are easy to harvest by simple mechanical processes.

Commentary on A PRESCRIPTION FOR KOSCIUSZKO" –Winter, 1987

By R.W.Condon, former special soil conservationist in charge of alpine reclamation for the Soil Conservation Service in the 1960s and member of the then
Kosciuzko State Park

The piece on 'A Prescription for Kosciuszko" was an item in *Ecos* a quarterly or bi-monthly put out by CSIRO Publications. There were lots of statements that didn't seem to match with reality. In the attached material, the statements that didn't match with reality have been repeated, and a paragraph or two written about the mismatch with reality.

The above article begins:-

"No livestock, no control burning and no rabbits. Thats the prescription (more a proscription) for preserving our sub-alpine environment, according to the results of an eight-year study by CSIRO researchers in the Kosciusko National Park"

This critique examines the article in detail and discusses those points which seem to be odds with the facts, on the broad scale, as seen on much of the Kosciusko National Park (KNP) during a four-day inspection of sub-alpine woodland and grassland areas within the park - including areas which had been closed to grazing for thirty years, which had also not been burnt for a similar period, other areas which had been burnt in various times over the last six years and which also had an infestation of rabbits. The analysis is made in relation to the desirable objective of diversity of species, a range of communities and successional stages and, for the tourist, a display of wildflowers in January of each year.

A. Page 17- Column 1 - Paragraph 1 - 2nd Sentence.

> "Close study of experimental plots on the Kiandra Plain has now shown that fire and rabbits gradually increase the amount of erosion-susceptible bare ground, and that rabbits can have a devastating impact on alpine flower species."

If this is the conclusion arrived at after "close study" for eight years, the findings are narrow in the extreme. One can work much more effectively from known facts and expectations rather than endeavour to prove something by research to support a particular thesis.

Fire and/or rabbits will probably increase the amount of bare ground. In respect of fire in alpine grassland the increase in bare ground will depend on:-

(a) the severity of the fire, i.e.,
(i) whether carried out under mild conditions or on low or moderate fuel loads (little bare ground)
(ii) whether under mild fire on moderate to high fuel loads (lots of bare ground), or
(iii) whether under moderate or severe conditions on moderate to high fuel loads (devastation).

In the case of a(i) we can expect a quick recovery of the half burnt snow grass with a good occupation of the small bare spaces between tussocks by the good representation of herbaceous species which there will normally be in a light fuel load. If grazing pressures by rabbits (or livestock) or other animals (native or feral) are light, and seasonal conditions are near normal, the alpine flowers will beat the grazing pressure and put on a reasonable display. If the area can be kept free of grazing animals until January the wild flowers will be at crop density.

In the case of A (ii), the recovery of snowgrass will be scattered and the planned responses will be from colonising type herbaceous species, more likely dominated by the indigenised sorrel (Rumex acetosella). It will be essential to ensure complete freedom from grazing by any animals including natives, to ensure that the plants succession will

progress from a sere dominated by vigorous colonisers to one in which the more vigorous forbs (herbaceous species) dominate to a later sere in which snow grass is co-dominant with the forbs.

(At this stage there will be maximum display of alpine flowers and reasonable stability of the snow grass. From the aspect of maximum yield of wild flowers for maximum tourist appreciation, it would be desirable to hold the succession at this stage by permitting a reasonable level of grazing by native animals (of which there will not be enough because of the limited opportunities for them in the overgrown sub-alpine grassland) or preferably domestic animals which can be carefully controlled in terms of numbers, time and space.

In the case of a(iii), the vegetation on the surface will be completely consumed, organic matter on and in the surface of the soil will likewise be consumed leaving only mineral soil at the surface. The layer of fine ash containing most of the plant nutrients which were present in the standing and senescent snow grass hay will be blown away and washed away (if on a steep slope or in an area subject to floods or overland flow.)

B. Page 17 - Column 1 - Paragraph 2 - Sentence 1.

"Rabbits.....have not previously been seen as a significant problem for the integrity of the KNP."

Within the park, over the areas that have not been grazed for 30 years, rabbits have not been seen for two reasons:-

(i) rabbits cannot survive in tall grass because they become easy prey for their usual predators - the hawks.

(ii) rabbits cannot survive in tall, dead and senescent grass because there is nothing for them to eat. They can only survive on short green pick.

The only places that rabbits can possibly survive in the KNP sub-alpine grassland and woodland areas are:-

(1) those areas which have been recently visited by fire and the recovering grass and herbage is short and green. One such area is the Botheram Plain where a fire in 1982 rejuvenated the dense snow grass and encouraged grazing by brumbies and rabbits. When inspected in October 1987 it supported a diverse vegetation of plentiful forbs and light snow grass, but no where was there any sign of erosion after four summers of uncontrolled grazing by feral animals (including pigs). The rabbits have brought under control by poisoning. If the brumbies are likewise brought under control (perish the thought) and seasonal conditions are reasonably normal, there will be an excellent display of wild flowers on Botheram Plain in January 1988.

C. Page 17 - Column 1 - Fourth Paragraph - First Sentence.

"Just like the livestock before them, (the rabbits) avoid the tough snow-grass tussocks"

Neither rabbits nor livestock avoid short closely cropped and freshly growing snow grass if and when it is available.

Both have much difficulty coping with tall dense dead and senescent snow grass which currently occupies 99.99% of the sub-alpine and woodland in the KNP in those areas not taken over by dense scrub in recent years.

D. Page 17 - Column 2 - Paragraph 1 - Sentence 2.

"(The) herbaceous plants, distinct from the grasses, comprise only about 3% of the total ground cover, and generally produce the alpine flowers that in summer give our mountain areas their special appeal."

In the sub-alpine woodland and grassland (SAW & G) the percentage of the total ground cover occupied by forbs will depend upon past grazing (and fire) history. A figure of 3% suggests a period of 10-15 years without grazing (or fire). Thirty years without fire or grazing (by domestic live stock or native animals) will give a figure of 0.03%. At 5 years with no grazing the forbs will provide around 30% of the ground cover. When grazing has been continuous for over 100 years, the plants will be vigorous although short, and the forbs will provide 60-80% of the ground cover. If livestock are kept off such areas in January each year the wildflower display will be truly magnificent. (See photo No. 1).

E. Page 17 - Column 2 - First Paragraph - First Sentence.

"Livestock Eliminated.

"The damage wrought by more than a century of grazing by cattle and sheep (accompanied by the annual autumn burn to"sweeten the pick") was recognised decades ago."

There are two points to query.

(1) Damage.

It is becoming increasingly evident that more than a century of grazing by sheep and cattle has wrought very limited damage in the SAW & G of the KNP. Areas of severe erosion occurred only at elevations above 2,000 metres (alpine rather sub-alpine) in most exposed locations probably more directly as a consequence of the 1939 bushfires and the following heavy rains in that year and subsequent drought year conditions from 1940-1945, rather than one hundred years of grazing.

It would be more correct to state that :- "decades ago, the public and politicians, were hoodwinked into believing that 100 years of sheep and cattle grazing and associated burning had wrought erosion damage severe enough to warrant termination of the snow lease grazing which, to that time, had been carried out under rather primitive conditions and management practises. Time(and the inevitable effects of extreme wild fire) will show the political decision to remove domestic livestock from the sub-alpine regions as creating infinitely more damage to natural values and catchment values than livestock ever did or will ever do.

(2) Burning.

The statement "accompanied by the annual autumn burn" to 'sweeten' the pick" gives the impression that grazing areas would have been burnt annually. If this happened on the same areas every year, it would indeed be a detrimental practise which would become self defeating because there would soon be nothing to burn.

However, after a summer of grazing, the stock would have kept 70-80% of the grassland eaten down to the point where it would run a fire only under the most severe conditions. The other 20-30% would be coarse, tussocky material become so because it had become increasingly ignored by livestock - in fact becoming a mausoleum in terms of natural values.

These areas, generally in small patches of a hectare or so, would be the only areas that would burn under the milder conditions of late autumn.

Unless the fuel load was enormous (it is difficult to imagine the stockmen allowing this to happen) the resultant burn would have plenty of half burnt material to protect the soil, to hold the ashes, and space for the regeneration of the forbs - which would become feed for livestock or a wildflower display depending on subsequent management.

Under such a regime, it is difficult to imagine any area in the mountains being burnt more often than once in 5 or 10 years. Put another way, there would have been about 10-20% of the landscape burnt over each year. This is probably less than the Aboriginal would have done when they came up to the mountains for the Bogong moth feasts.

F. Page 17 - Column 3 - Top Half Paragraph.

> "... livestock were banned from the NSW high country in 1958 - when up to 40% of the sub-alpine grassland had become bare soil."

This very loose statement is part of the "hoodwinking" process mentioned earlier and is here no doubt intended to further hoodwink a public condition ed to believe that scientists are honest people and CSIRO scientists particularly so.

The statement says in effect that, in 1958, up to 40% of the sub-alpine grasslands had become bare soil. But what does it actually mean? The range of possible meanings is enormous, depending on how you feel about cattle and sheep grazing in the mountains.

If the reader has a hang up about this he will understand it to say that nearly 40% of the sub-alpine grassland woodland was bare soil. This would be truly horrific if the bare spaces were 20 metres square and even more horrific if they were 100 metres square.

But what if they were only 10 cms square (in which case there would be no problem as the area would be close to the ideal) or 20 cms square when one would be beginning to get concerned about the continuing stability if it were on a steep slope, but not too much concerned if the slope were nearly flat.

But what was the real position in 1958?

The author of this critique was not there in 1958 but he did spend much of the 5½ years between 1962 and 1968 walking, riding being flown over and being driven over all sub-alpine regions between The Pilot in the south and Cooleman Plain in the north. His assessment is given in the following paragraphs.

Bryant (1971) reported the results of a detailed survey of erosion in the Upper Snowy (Guthega Dam) catchment for which the field work was carried out in 1967-68. The results of this survey show that if all the bare soil in the minor, moderate and severe sheet erosion classes were put into one large area, such area would represent only 5.7% of the total of 22,000 acres in the catchment - 90% of the erosion mapped and recorded in this catchment was in the mostly steep, exposed and very vulnerable country above 2,200 metres forming the Main Range from Mt. Northcote through to Mt. Twynam with some scattered areas further north. A further 3% of that area was either snow drift or feld-mark (stone pavement) some of which would have been extended or accentuated by accelerated erosion. (Elsewhere, it is shown that there is substantial doubt as to whether we can blame grazing and associated burning practises for the very severe erosion in this area.)

Along the Main Divide, north eastward of that within the Guthega Catchment, there are scattered areas of severe erosion from 0.1 to 0.5 ha in size as far north as the Bulls Peaks. These areas would account for no more than 10% of the areas above 1,800 metres - much less than 1% of the total alpine and sub-alpine landscape.

In the sub-alpine grasslands(below 1,800 m) in 1962-68, there was a very occasional patch of severe erosion, rarely more than 0.1 ha in area representing perhaps 0.1% of the total landscape. Elsewhere, bare areas in excess of 30 cms diameter would not have amounted to more 0.01% (1 sq. m in 10,000 sq. m = 1 ha) of the total grassland landscape.

One has to ask how is the "up to 40% bare soil" arrived at - or was it a politically attractive figure.

G. Page 18 - First Column - First Four Paragraph - Second Sentence.

"Feral rabbits exert nearly all the grazing pressure on sub-alpine plant communities."

This may have been so in the rather narrow confines and objectives of the experimental work but whether they exert grazing pressure on sub-alpine plant communities depends on a number of factors.

If the grassland is tall senescent snow grass there are no rabbits and they can't exert any pressure whatever.

If the grassland is recently burnt country, rabbits will be attracted to it (if there are any in the vicinity) and they will use it heavily or lightly according to the numbers in relation to the area involved. They will keep such area as they need for their population in a condition which they can make most effective use of, extending it as needed.

Whether they exert nearly all, or all, or are only part of the grazing pressure on a sub-alpine plant community depends upon the population of wombats, kangaroos, brumbies (discounting feral pigs because they don't graze.)

H. Page 18 - Column 1 - Third Paragraph - Last Sentence.

"The number of (rabbit) pellets recovered and recorded by the researchers range from an average of three per square metre in unburnt snow grass to 408 per square metre in burnt woodland."

A lot trouble and demeaning work to prove what should have been obvious. Three pellets per square metre seems unduly high for unburnt snow grass - presumably there was room to squat or the rabbits were locked in with nowhere to go or perhaps the pellets were dropped by birds.

408 pellets per square metre in burnt woodland merely proves how desirable is the practice of burning - from the following considerations:-

(1) Improved feed for animals because of sweetness, freshness and the improved nutrient status, initiating

(2) an increased rate of nutrient cycling with obvious benefits to:-

    (a) soil physical condition and moisture regime

    (b) enhanced micro-flora and micro-fauna

    (c) enhanced plant growth, resulting in

(3) a greatly improved and dynamic natural environment.

The health of the range of communities in between the unburnt snow grass and the burnt woodland would improve or regress in relation to its ability to attract other grazing animals and the nutrient cycling that this would encourage.

I. Page 18 - Column 3 - 2nd Paragraph - Under Heading "Damaging Fire."

"..... substantial reduction in total bio-mass (although the number of species present remain almost the same)."

Whether a "substantial reduction in bio-mass" is damaging depends upon:-

(a) - in respect of catchment values:-

(i) whether we really need ten TPHA of bio-mass to prevent excessive runoff

- are we looking to protect totally against minimal erosion
- will there be years in which it would be helpful to have more runoff into storages

2. How long it takes to get back to 10 TPHA of protective cover rather than an overly protective cover which detracts from natural values (and perhaps from catchment values?).

(b) In respect of natural values

(i) Whether we want diversity of species under light cover or

(ii) senescence of species under heavy cover.

In the absence of a real erosion hazard, b(i) would seem to be the best compromise between catchment values and natural values.

J. Page 19 - Column 1 - First Full Paragraph - First Sentence.

> "Hence the latter-day scientists (hopefully not to be regarded as "latter day saints") contend that ideally, no man made fires should be allowed in the high country."

This lofty ideal would be in order if all the natural fires which would have burnt over the high country over the years had been allowed to do so unhindered by the efforts of man to put them out. The result, in terms of natural values (diversity of species and successional stages) would not be as good as that which prevailed under the fire regime of the Aboriginals nor that imposed by the stockmen, but it would be infinitely better for natural and catchment values than the present policy of total ban on man-made fires.

K. Page 19 - Column 1 - First Full Paragraph - Second Sentence.

> "Another effect of fire, discussed later, is an increase in bare ground, and this should not be tolerated."

A dogmatic statement which needs to be analysed in detail. Whether "bare ground" can be tolerated depends upon a number of considerations:-

(a) How bare?

(i) 50% bare in patches of 10-15 cms diameter is very tolerable - having plenty of space for herbs to occupy and provide good natural values, i.e., diversity of species etc.

(ii) 50% bare in patches greater than 30 cms diameter is stretching tolerability if it happens to be eroding but, after a moderate fire (because of a heavy fuel load) late in an autumn afternoon on country which would soon be covered with snow and which will shoot away vigorously in the spring, it would be quite tolerable.

( ) How big?

- patches of 10-20 ha making (a i) above would be tolerable. Burns with a result as for (a ii) would desirably need to smaller - say 1-2 ha.

(c) How long in time?

(i) A burn in tall dead grass in early spring should normally have enough green in it to provide a result much better than a (i) and will be a dense sward within a month from the snow melt moisture.

(ii) A burn in January-February under drought conditions will have to wait 3-5 months for a protective snow cover. No one in full possession of his faculties would deliberately light a grass fire under these conditions. But nature, in full possessions of its facilities, will do so one day and the result will be as March 1965 - horrific wildfire over tens of thousands of hectares.

One could go on. But we know enogh about fire and fire behaviour in relation to fuel types and weather conditions to dispense with the research and get on with the job of managing the environment as it should be managed - but not as a museum which the exhibits turn to petrol and become highly and explosively flammable.

L. Page 19 - Column 2 - Second Paragraph - Third Sentence.

"The researchers presume (the lack of shrub seedlings) was because the fires were of very low intensity."

They were very fortunate to have a fuel load which would carry no more than a low intensity fire - an impossibility over 99.99% of the sub-alpine grasslands today even if lighting up in the middle of the night in March.

Stockmen's fires would have been of low to moderate intensity, moderate because they would have been looking to burn patches of tall dead grass sheep and cattle would not touch, and generally of limited area. They would not have been interested in burning grass kept well eaten down by stock and, like the researchers, would have difficulty keeping a fire going in such a fuel.

M. Page 19 - Column 2 - Fourth Paragraph - 1st Sentence.

"... at no time did (the researchers) see shrubs colonising intact grassland or bare ground."

They obviously kept their eyes averted if they ever travelled through the grassland areas around the head of Tantangara Dam to Blue Water Hole, and particularly so if they were travelling through the Jagungal area where intact grassland has been densely colonised with shrubs two metres high all over the tops of the ridges and knolls, occupying 40-60% of the grassland landscape. Shrub numbers are increasing rapidly on the fringes. One can expect the centres to start dying out in another 20 years time. If the shrub invasion continues downslope into and across the valleys and swa les at the same rate as to the present, the bushwalkers will have no where to walk in the area in thirty years time.

(For verification check air photos Kosciusko Run 2? - 1979)

N. Page 19 - Column 2 - Paragraph 5 - Sentence 1.

> "(The researchers) assert that it is a combination of bare soil and reasonably high intensity fire which allows shrubs to get the upper hand."

This may be true of the alpine track and might be expected in the sub-alpine grasslands. But, apart from the March 1965 fire which went across the plain generally north of Kiandra (where there are now only occasional patches of shrubs) there have been no widespread fires of either high or low intensity in the Jagungal area since 1957 (with one exception - see below), the amount of bare soil present when the author walked over much of it in 1965 was infinitesmal (less than 0.01%).

> (Locals report an intense wildfire in the area to the north of Jagungal in the mid-1970's which killed all the scrub - and the snow gum.)

O. Page 19 - 3rd Column - First Paragraph (Part).

> "Before European man arrived with his livestock (about 1860) wildfires of high intensity were very rare."

One would have to agree, this being the case almost everywhere in Australia because of the Aborigines land use practise of patch burning. Snowy Mountains area was not exempt. If it was, lightning fires, ignited locally or several kilometres away would have done the same job.

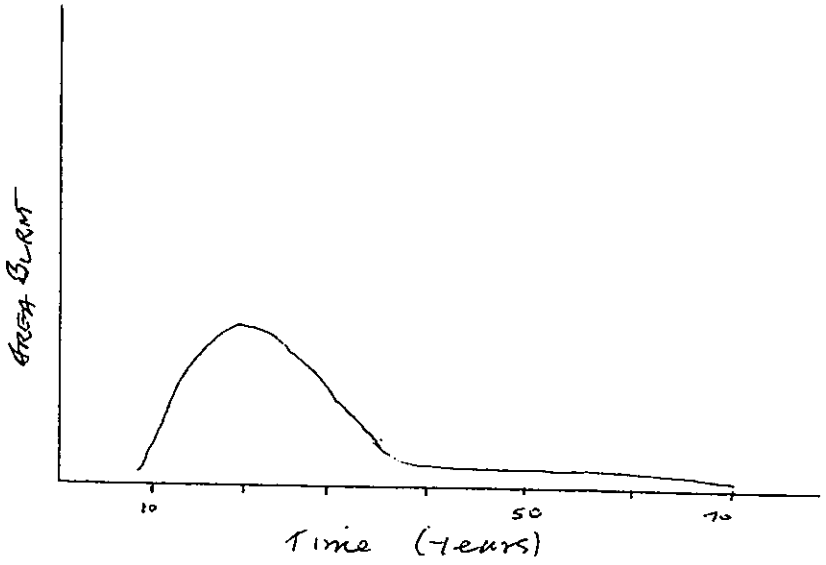
The sentence quoted needs to be qualified "...fires of high intensity over large areas were very rare." There would have been plenty of high intensity Aboriginal and lightning fires but of limited area.

O. Page 19 - 3rd Column - First Paragraph (part).

"Lower intensity fires probably recurred only at intervals of between 10 and 70 Years".

The range is much too broad for Aboriginal and lightning managed country. Lets say "5-20 years with some small areas surviving perhaps 50 years without visitation by fire." The relationship would be something like the graph below.

Graph ?
See 11/12/83.



P. Page 19 - Column 3 - First Full Paragraph.

> "..... levels of 40% or more were common when grazing leases were withdrawn (in 1958)."

The 40% synodrome becoming endemic. What is meant by "40% bare" and how frequent is "common"?. Refer again to item F for a return to reality.

Q. Page 19 - Column 3 - Last Sentence.

> "Although frequent burning kept the shrubs down, they sprouted forth everywhere after 1958, and only now are beginning to dwindle."

One has to ask - "where did (the shrubs) sprout forth everywhere after 1958?? Present occupation by shrubs in the Long Plain- Rule's Point area is less than 10% (casual observation) - around the head of Tantangara Dam about 20-40%. These areas remain free of shrubs for a long time after 1958, although it must have been gradually building up from a few scattered individuals.

The author recalls the grassland south and south east of Jagungal as being virtually shrub free in 1965 (8 years after stock were removed). It is now dense at 40-60%.

They are not now beginning to dwindle but are pushing out from the edges of each stand with vigour.

R. Page 20 - Column 1 - 2nd Full Paragraph.

> "...earlier work has demonstrated that soil loss can occur when a proportion of bare soil is abused as little 1-2%."

The earlier work has since been discarded by later work on the more gently sloping Bogong High Plains (van Rees 1980?). But soil loss at 1-2% bare is really stretching the imagination. How far did the lost soil travel - 2cms, 20 cms, 200 cms or 200 metres or 2,000 metres?.

What sort of spaces comprised the 1-2% of bare ground - 2cms, 20 cms or 200 cms? (Refer again to Item F.)

(RWC to check original research as to method??)

Soil loss from bare ground is a function of:-

- the size of individual bare patches - the bigger the bare patch the greater the soil loss per unit area and the more difficult the re-colonisation process.
- the slope - the steeper the slope and the less the obstructions, the greater the velocity of surface flow, its greater its scouring power and the greater its carrying capacity (for suspended sedimented).

S. Page 20 - First Column - 2nd Full Paragraph - 2nd Sentence.

> "As a result of the first experimental fire the rabbit free plots contained 18% bare ground 18 months afterwards etc and four years later more than 5% of the ground was still bare."

This is the end of the discussion on fire and is presumably meant to be a heart-rending conclusion. But it means nothing unless we know the nature of the bare areas, and what happened to the soil which may have been floated off the 18% of bare ground. If it moved only 30-50 cms, that is a natural process in any natural environment exposed to its fair share of Aboriginal and lightning caused fire.

If there is no such soil movement on a reasonable slope, it is no longer a natural environment - like the tens of thousands of hectares of senescent snow grass presently in the KNP which would require at least 10 mms of rainfall before enough rainfall moisture got through the enormous load of dry hay to reach the soil. But how long will that last when the first fire arrives - whether natural or deliberately or accidentally lit.

T. Page 20 - Column 2 - Middle Paragraph.

> "All these behavious patterns (close cropping, digging and scratching, and localised dunging) gradually disturb the native vegetation."

In the present management climate of over-protection of the native vegetation from the natural disturbances it would be likely to experience in the wild, disturbance by rabbits here and there might be just what the environment needs to provide that diversity of species and communities so sought after by the vocal conservation movement.

One could expect a gradation of levels of disturbance in inverse relation to the distance from a rabbit warren or other centre of population. One would find the most diverse communities near but not on the outer edge of the "target spot" so created, the area back to the centre of the population suffering from excessive "disturbance" and that beyond the influence of rabbits suffering probably more so, from lack of disturbance.

One area within the KNP sub-alpine area, having been burnt in 1982 and kept short but not bare in condition by a moderate infestation of rabbits until recently treated, and a mild infestation of brumbies, was recently seen to be in mostly excellent condition, grassland areas ranging from tall dense senescent and dead snow grass to close-cropped mown grass, with the frequency of wild flower species varying as described in the previous paragraph.

The researcher believes that by eliminating fire to reduce the 'green pick' available to rabbits and additional campaigning by a hand full of workers, the rabbits could be eliminated, from the sub-alpine region of the KNP.

> "In this way, the environment could revert, as far as possible, to its natural beauty."

However, in the absence of fire, the "natural beauty" would be short lived. In five-ten years the snow grass would have swamped everything and wild flowers would gradually disappear, as has happened over practically all the sub-alpine grasslands not grazed regularly and closely

by kangaroos and wombats attracted to small oases left by man, either as ex SMA camp sites or pocket handkerchief horse paddocks around former stockmen's huts.

If we lock up nature it will certainly revert - to a somnambulent senescence. Certainly not a thing of beauty but a death community in which plant nutrients are tied up in standing hay for many many years.

There is only one way to stop the rot of death and non-decay that is presently eating at the heart of the KNP. Institute positive management using nature's disturbance of mild and moderate fire to create the necessary diversity of species in communities and successional stages to keep the plants alive and reasonably free of the holocaustic destruction that will otherwise inevitably come.

If we dare let ourselves even think a tiny bit about introducing domestic livestock and bring ourselves to look at the vitality and youthful vigour and wildflower displays on the Snowy Plain which has been grazed for over 100 years, we might get to appreciate that we can "manufacture" dozens of natural environments throughout the grassland and woodland.

We have the choice - do it now or let it stagnate and be truly sorry when it is converted to smoke and ashes all over.

N. Page 19 - Column 2 - Paragraph 5 - Sentence 1.

> "(The researchers) assert that it is a combination of bare soil and reasonably high intensity fire which allows shrubs to get the upper hand."

This may be true of the alpine track and might be expected in the sub-alpine grasslands. But, apart from the March 1965 fire which went across the plain generally north of Kiandra (where there are now only occasional patches of shrubs) there have been no widespread fires of either high or low intensity in the Jagungal area since 1957 (with one exception - see below), the amount of bare soil present when the author walked over much of it in 1965 was infinitesmal (less than 0.01%).

> (Locals report an intense wildfire in the area to the north of Jagungal in the mid-1970's which killed all the scrub - and the snow gum.)

O. Page 19 - 3rd Column - First Paragraph (Part).

> "Before European man arrived with his livestock (about 1860) wildfires of high intensity were very rare."

One would have to agree, this being the case almost everywhere in Australia because of the Aborigines land use practise of patch burning. Snowy Mountains area was not exempt. If it was, lightning fires, ignited locally or several kilometres away would have done the same job.

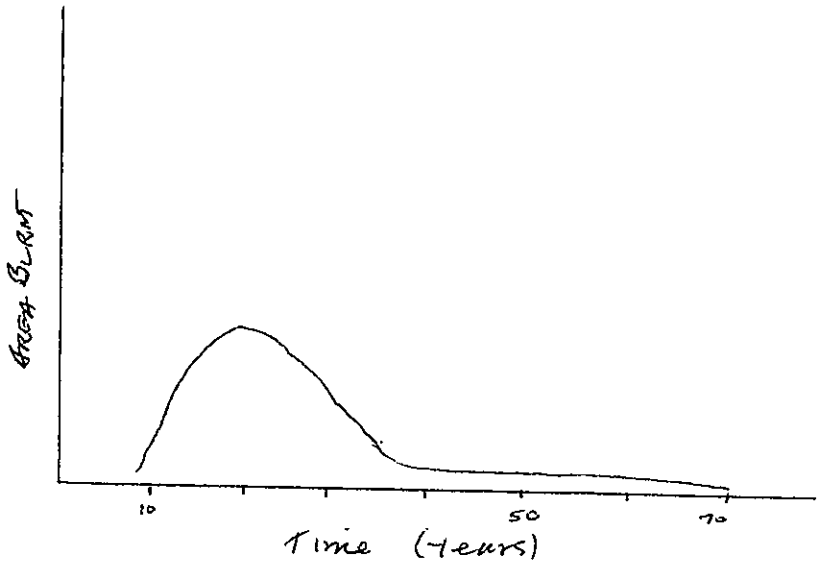
The sentence quoted needs to be qualified "...fires of high intensity over large areas were very rare." There would have been plenty of high intensity Aboriginal and lightning fires but of limited area.

O. Page 19 - 3rd Column - First Paragraph (part).

"Lower intensity fires probably recurred only at intervals of between 10 and 70 Years".

The range is much too broad for Aboriginal and lightning managed country. Lets say "5-20 years with some small areas surviving perhaps 50 years without visitation by fire." The relationship would be something like the graph below.

Graph ?
See 11/12/83.



K. Page 19 - Column 1 - First Full Paragraph - Second Sentence.

> "Another effect of fire, discussed later, is an increase in bare ground, and this should not be tolerated."

A dogmatic statement which needs to be analysed in detail. Whether "bare ground" can be tolerated depends upon a number of considerations:-

(a) How bare?

(i) 50% bare in patches of 10-15 cms diameter is very tolerable - having plenty of space for herbs to occupy and provide good natural values, i.e., diversity of species etc.

(ii) 50% bare in patches greater than 30 cms diameter is stretching tolerability if it happens to be eroding but, after a moderate fire (because of a heavy fuel load) late in an autumn afternoon on country which would soon be covered with snow and which will shoot away vigorously in the spring, it would be quite tolerable.

( ) How big?

- patches of 10-20 ha making (a i) above would be tolerable. Burns with a result as for (a ii) would desirably need to smaller - say 1-2 ha.

Review (by R.W. Condon, Rangeland and Environmental Consultant) of

Fire and Grazing in a shrub-invaded arid grassland community -- independent or interactive ecological effects

T.A. Valonr and A.A. Kelt (U.S.A.)

In the *Journal of Arid Environments* (1999) 4 2 ; (15-28)

The attached extract from the above paper include only the first two (Introduction) and last two pages (Discussion) The introduction serves to review all the other papers related to the particular study, the discussion serving to review the findings by the authors, and other researchers.

Note that, in the following material, the reviewer's comments are in a different font (this one) to material taken more or less directly from the paper

The study examined the responses of summer and winter annuals and perennials in a shrub-invaded arid plant community to combinations of fire, and grazing by cattle -- to determine the effects on individual abundances, species richness and diversity.

The object of this review is to examine its relevance to the alpine and subalpine situation in Australia where shrubs have been invading grassland and about which there is some disagreement as to the reasons for such invasion. The researchers on this subject in the Victoria alpine areas have been trying hard to prove that cattle grazing in such areas will serve to encourage invasion of grassland by shrubs -- whereas those who spend much time in the field, and with plentiful opportunities to observe what is happening, pointing to the opposite happening in the Victorian and NSW high country., i.e. shrubs invading in the absence of cattle grazing and in areas where cattle grazing has been reduced substantially from former times.

Although the situations between arid and sub-alpine grasslands are very different it is expected that the same principles will largely apply.. The main differences between arid and alpine grasslands is that the former have much more space between individual plants but, because of the general lack of soil moisture, much less opportunity for shrubs, or other species, to occupy those spaces. There is also some discussion of what happens, and how it happens, with fire and grazing in mesic (noderate rainfall) grasslands, this being more pertinent to sub-alpine grasslands.

The authors point out, firstly, that the frequency and intensity of disturbances strongly affect the structure of many plant communities but, in many systems, an intermediate level of disturbance generates the highest levels of species richness. Intermediate levels of disturbance allow succession to proceed but limit the ability of competitive species to dominate the community.

By contrast, in areas in the Kosciusko National Park in NSW which have been ungrazed for over 50 years , and unburnt for nearly 30 years, the normally dominant snowgrass native to the area has become dominant to the exclusion of almost all other species or plants, the snowgrass itself being comprised, towards the end of each summer season, of 80-90% dead leaf material and 10-20 % of green leaf material, the current year's green material then adding to the following year' dead material.

The authors were seeking particularly to determine the effects of multiple disturbances on community structure as well as those caused by a single disturbance. Other researchers have shown that in mesic (moderate rainfall) grasslands, multiple disturbances (grazing, burning and soil disturbance) interact to increase species richness and diversity. These types of disturbances combine to open up space for colonisation and reduce the competitive superiority (**of the would-be dominants**), which promotes the maintenance of high levels of plant diversity.

In North America and around the world woody shrub density has increased and grass cover has declined. Most ecologists attribute this to two major shifts in the disturbance regime -- grazing by herbivory, and the decrease in the disturbance frequency and intensity of wildfire around the world. over the past century -- because wildfires have been widely suppressed, and grazing cattle serve to reduce fuel loads. Shrubs are more susceptible than grasses to fire, and so, a reduction in fire frequency and/or intensity can promote shrub establishment.

Many studies have examined how manipulation of fire or grazing alone have each affected shrub-grassland communities, such studies identifying species that respond positively or negatively to each disturbance type. Few studies have examined these treatments simultaneously -- so that it is not clear how these disturbances might interact. This study has examined the responses of common individual species as well as community richness and diversity to determine whether combined grazing and burning treatments generate the highest levels of plant diversity. Specifically they were interested in determining whether the re-introduction of fire would result in high levels of shrub mortality and increased grass cover.

Effects on shrubs

Shrub density and vegetative ground cover declined on all plots during the study.-- ωηιχη ωουλδ βε εξπεχτεδ ιν αν αριδ ενωιρονμεντ. Some shrub species were severely affected on the burn plots while others (*Acacia* ap. and others) resprouted after the burn.

Discussion

They found no effect of grazing on species richness or diversity in this study.

Burned plots contained more individuals and often contained higher species richness than unburned plots. This could have important effects in encouraging seed-eating animals, especially birds, with greater seed availability.

Another researcher found that found that species richness in mesic grasslands increased significantly with increasing disturbance, with species richness being highest on plots that were both grazed and burned. This favouraable influence in mesic grasslands as opposed to arid grasslands is probably due to the fact that disturbance in mesic grasslands provides open space for colonisation -- whereas arid grasslands have plenty of open space without disturbance, and in this instance the researchers had to use artificial fire to create burning effects.

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Fire and grazing in a shrub-invaded arid grassland community: independent or interactive ecological effects?

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This study examined the response of summer and winter annuals and perennials in a shrub-invaded arid plant community to combinations of fire and grazing by cattle to determine their effects on individual abundances, species richness and diversity. Thirteen species differed significantly in abundance across the burn treatment while nine differed significantly across the grazing treatment. Summer and winter annual plants were significantly more abundant, and summer annual plant species richness and diversity were significantly higher on burn plots. Most species were affected either by burning or grazing indicating that these disturbances affect this plant community relatively independently.

Keywords: disturbance; grazing; fire; plant; species richness; diversity

Introduction

The frequency and intensity of biotic and abiotic disturbances strongly affect the structure of many communities (e.g. Sousa, 1984; Petraitis *et al.*, 1989; Hobbs & Huenneke, 1992). In many systems, an intermediate level of disturbance generates the highest levels of species richness and diversity (e.g. Connell, 1978; Sousa, 1984; Gibson & Hulbert, 1987; Petraitis *et al.*, 1989; Collins *et al.*, 1995; but see Yodzis, 1986). The mechanism underlying this pattern is thought to be straightforward: relatively few ruderal species dominate when disturbances are frequent, and relatively few highly competitive species dominate when disturbances are rare; intermediate levels of disturbance allow succession to proceed but limit the ability of competitive species to dominate the community (Connell, 1978). Most prior investigations of the role of disturbance on community structure have examined how variation in a single type of

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disturbance affects communities. Many systems, however, are exposed to several kinds of disturbance, but it is less clear how multiple interacting disturbances might affect community structure (Collins, 1987; Chaneton & Facelli, 1991; Hobbs & Huenneke, 1992).

Grasslands are ideal systems to study the effects of multiple disturbances on communities because they are subjected to numerous disturbances, including fires, grazing by herbivores, soil disturbances and periodic droughts (e.g. Collins & Barber, 1985; Hobbs & Huenneke, 1992). While there exists information on how variation in each one of these individual disturbances affects grassland communities (e.g. Milchunas *et al.*, 1988; Puerto *et al.*, 1990; Collins & Wallace, 1990; Hobbs & Huenneke, 1992), few experimental analyses have assessed how multiple disturbances interact to affect community structure (but see Belsky, 1992). A notable exception is the work of Collins and co-workers at the Konza prairie. In this mesic grassland, multiple disturbances (grazing, burning and soil disturbance) interact to increase plant species richness and diversity (Collins & Barber, 1985; Collins, 1987; Collins & Gibson, 1990). The above disturbances combine to open space for colonization and reduce the competitive superiority of dominants, which promotes the maintenance of high levels of plant diversity (Collins, 1987).

While all grasslands are subjected to multiple disturbances, arid and mesic systems are very different. Over the past 125 years, widespread desertification has occurred in many arid grassland habitats in North America and around the world: woody shrub density has increased dramatically and grass cover has declined (Hastings & Turner, 1965; Glantz, 1977; Mabutt & Floret, 1980; Humphrey, 1987; Archer *et al.*, 1988; Dick-Peddie, 1993; Archer, 1995). Most ecologists attribute these changes largely to two major shifts in the natural disturbance regime. First, herbivory (grazing disturbance) increased dramatically following the introduction of large numbers of domestic cattle in historic times; intense grazing by cattle often reduces grass cover and promotes shrub establishment (Bahre, 1991). Second, the frequency and intensity of wildfire disturbance were greatly reduced over the past century; wildfires have been rapidly suppressed and domestic cattle have reduced fuel loads (Wright, 1980; Pyne, 1984; Bahre, 1991). Shrubs are more susceptible than grasses to fires, and so a reduction in fire frequency and/or intensity can promote shrub establishment (Reynolds & Bohning, 1956; Cable, 1967; Martin, 1983).

A substantial body of literature has examined how manipulations of grazing and fire alone each affect shrub-invaded grassland communities (e.g. McClaran & Van Devender, 1995). Such studies often identify species that respond either positively or negatively to each disturbance type (e.g. Chew, 1982; Hennessy et al., 1983; Martin, 1983; Bock *et al.*, 1984; Bock & Bock, 1988). However, most workers have focused on plant community responses to single manipulations of either grazing or burning; few studies have examined these treatments simultaneously. Thus, while it is clear that grazing and fire affect arid grassland plants, it is less clear how these disturbances may interact.

Here, we examine the effects of cattle grazing and fire on a plant community that appears to have been invaded by woody shrubs within historic times. We investigate the responses of annual and perennial plants to combinations of burning and grazing treatments for 2 years following a prescribed burn at a site that has contained a large cattle exclosure since 1977. We examine both the responses of common individual species as well as community richness and diversity to determine whether combined grazing and burning treatments generate the highest levels of plant diversity. Simultaneously, we were also interested in examining how the re-introduction of fire into this ecosystem would affect the plant community. Specifically, we were interested in determining whether the re-introduction of fire would result in high levels of shrub mortality and increased grass cover (e.g. Cable, 1967; Martin, 1983).

Winter community

In the first winter after the burn, 54 species were identified, 28 annuals and 26 perennials. The abundance of annual plants was significantly higher on plots that had been burned (Table 3). Richness and diversity of annual and perennial species exhibited no significant differences across treatments (Tables 3 & 5). There was a significant interaction effect of burning and grazing on species richness (Table 3), with highest richness on ungrazed and unburned plots.

Fourteen species were sufficiently common to analyse individually. Four annuals were significantly more abundant on burned plots, while one (*Erodium cicutarium*) was significantly more abundant on unburned than burned plots (Table 3). Three annual species, including the grass *Vulpia octoflora*, were more abundant on ungrazed plots, while two species were more abundant on grazed plots (Table 3). Four species exhibited significant interaction effects between treatments.

In the second winter after the burn, 44 species were recorded, 29 annuals and 15 perennials. Once again, the abundance of annual plants was significantly higher on burned plots (Table 4) while richness and diversity of both annuals and perennials again did not differ significantly across treatments (Tables 4 & 5).

Twelve species were sufficiently abundant to analyse individually. Three annuals were significantly more abundant on burned than unburned plots, while two were more abundant on unburned than burned plots (Table 4). Several annuals responded significantly to the grazing treatment. Two species were significantly more abundant on ungrazed plots while three others were more abundant on grazed than ungrazed plots. Only *E. cicutarium* exhibited a significant interaction effect: it was most abundant on unburned, grazed plots (Table 4).

Shrubs

Shrub density and vegetative ground cover declined on all plots during the study (Table 6). For example, densities of *G. sarothrae*, *A. constricta*, and *E. trifurca* declined approximately 80, 70, and 33%, respectively, from 1993 to 1995. All *G. sarothrae* individuals on burn plots were killed by the fire and subsequently recruited slowly. During the study, however, many *G. sarothrae* individuals on unburned plots died during the prolonged drought so that all plots exhibited similar low densities of this shrub in 1995. There was very low fire mortality for *Ephedra trifurca* and *Acacia* spp. as many individuals resprouted after the fire. This fact, combined with some mortality on unburned plots, resulted in similar densities of these shrubs across treatment plots (Table 6).

Discussion

We observed numerous responses by individual species to the experimental treatments (Table 7). The burning treatment influenced more species in this plant community than did the grazing treatment. In total, 13 species responded significantly to the burning treatment: eight were more common and three less common on burn plots; two other species responded oppositely to the burn treatment in the 2 years of the study. Just

Mean ground cover across treatments in 2 years and results of repeated measures ANOVAs. Ground cover is denoted as the actual of counts recorded per 500 census locations except for bare ground which is given as a percentage. Significant effects are indicated in (after sequential Bonferroni adjustment to maintain table-wide significance level of 0·05, Rice (1989)). See Table 1 for treatment abbreviations

Ground cover									ANOVA *p*-values			
1993				1995					Factor			
Treatment				Treatment								
+B+G	+B−G	−B+G	−B−G	+B+G	+B−G	−B+G	−B−G		Burning	Grazing	Year
77·6	72·2	79·2	82·8	96·2	95·2	90·8	93·6		0·5213	0·9926	0·0001
8·2	9·6	1·0	4·4	1·8	5·0	1·4	2·2		0·0672	0·2932	0·1299
64·8	81·6	67·2	63·2	7·0	2·0	7·4	0·2		0·6753	0·9848	0·0001
17·8	31·0	17·4	7·6	1·6	4·4	6·2	3·4		0·2678	0·8506	0·0027
1·8	6·2	0·4	0·6	3·0	7·8	13·6	8·4		0·7920	0·7920	0·1416
20·4	14·8	9·0	6·6	3·4	3·2	8·4	10·0		0·4633	0·5344	0·0197
0·0	2·2	0·0	4·8	0·0	0·8	0·0	6·0		0·3388	0·0955	0·9803
1·2	3·2	2·2	0·8	0·2	0·6	3·6	0·4		0·7258	0·6683	0·6128
1·6	2·6	5·2	0·2	0·0	0·0	5·2	1·0		0·3395	0·2906	0·6589

Table 7. *Summary of statistically significant plant responses to experimental treatments. s = summer annual; w = winter annual; p = perennial*

Species found in highest abundance on burned plots:

Bouteloua aristidoides (s)
Euphorbia serrula (s)
Mollugo cerviana (s)
M. verticellata (s)
Portulaca parvula (s)
Cryptantha micrantha (w)
Descurainia pinnata (w)
Gilia sinnuata (w)
Spermolepis echinata (winter 1994)
Eriogonum abertianum (winter 1995)

Species found in highest abundance on unburned plots:

E. abertianum (summer 1993)
Gutierrezia sarothrae (p)
Polygala tweedii (p)
Erodium cicutarium (w)
S. echinata (winter 1995)

Species found in highest abundance on ungrazed plots:

P. tweedii (p)
D. pinnata (w)
Eriastrum diffusum (w)
Vulpia octoflora (w)
E. abertianum (winter 1995)

Species found in highest abundance on grazed plots:

G. sarothrae (p)
E. cicutarium (w)
G. sinnuata (w)
Plantago purshii (w)

The heterogeneous responses observed to the experimental treatments may reflect the evolutionary histories of individual species and/or the ecotonal aspect of this community. The geographic ranges of the winter annuals tend to extend westward into the Sonoran and Mojave Deserts, while the ranges of the summer annuals tend to extend eastward to the Great Plains, Desert Grassland, and Chihuahuan Desert (Kearney & Peebles, 1960; McClaran & Van Devender, 1995). The latter might be expected to have evolved in association with fire and grazing by large herbivores more so than the former (*cf.* Wright & Bailey, 1982; Milchunas *et al.*, 1988; Bock & Bock, 1992). This may explain two observations: many summer annual species responded positively to the burning treat-

The response of the annual plant communities to the grazing treatments was somewhat unexpected because previous studies of the effects of grazing on annuals in the south-west have found that species richness is lower on plots grazed by domestic cattle (e.g. Waser & Price, 1981; Bock *et al.*, 1984; but see Kelt & Valone, 1995). We found no effect of grazing on species richness or diversity in this study. While a total of nine species responded significantly to the grazing treatment, such individual differences did not translate into strong differences in species richness or diversity across the grazing treatment because similar numbers of species responded positively and negatively to grazing (Table 7).

The burning treatment resulted in high levels of mortality for *G. sarothrae* and increased abundance of the annual grass *B. aristidoides* over a 2-year period. Other shrub species, however, resprouted after the fire and there was a concomitant reduction in shrub density on unburned plots presumably due to drought. In addition, no other grasses responded positively to burning. Many perennial grass species occur at the site and some, such as *Eragrostis lehmanniana, Muhlenbergia porteri,* and *Aristida longiseta* are fairly common (Brown & Heske, 1990; Heske *et al.*, 1993). One likely explanation for the weak response of perennial grasses in this study is that such species may require abundant summer precipitation for establishment (*cf.* Cable, 1975; Neilson, 1986), and the precipitation in both summers was below average.

Over the duration of the study, however, burned plots consistently contained more individual annuals than unburned plots both in summer and winter. Our summer plant results are consistent with previous work which has shown that summer annuals in Chihuahuan Desert and semi-desert grassland habitat increase in abundance following fire (Ahlstrand, 1982; Bock & Bock, 1992). Our winter plant results, however, differ from the findings of Cave & Patten (1984) who documented a significant reduction in the abundance of Sonoran Desert winter annuals following fire.

The fact that burned plots contained more individuals and often contained higher species richness than unburned plots has potential implications for other aspects of the ecosystem. The seeds of these plants are an important food resource for many granivorous rodents, birds, and ants (Thompson *et al.*, 1991; Samson *et al.*, 1992; Guo *et al.* 1995). These results suggest that burning may have positive effects on such animals if seed production is correlated with plant density (Bock *et al.*, 1976; Bock & Bock 1988).

Our results differ from those of Collins (1987) who found that species richness in a mesic grassland community increased significantly with increasing disturbance: at the Konza prairie, species richness was highest on plots that were both grazed and burned (Collins, 1987). In our study, plots that were both burned and grazed did exhibit the highest levels of diversity in summer but plots that were burned and ungrazed had similarly high levels of diversity (Table 5). In winter, the burning and grazing treatments had little consistent effects on diversity. Thus, there is no indication that burning and grazing interact in this system to produce high levels of diversity.

One factor that may explain the different responses of mesic and arid grassland communities to grazing and burning treatments is differences in vegetative ground cover. In mesic grasslands, disturbances open space for colonists (Collins, 1987). On the arid community, on the other hand, was dominated by open space prior to burning (Table 6). While fire did kill some shrubs and top-killed all shrubs which created open space for colonists, concurrent drought also reduced shrub density on the unburned

disturbances typically affect species and communities independently as in this arid system, or whether they more typically interact as in mesic systems (Collins, 1987). The re-introduction off fire into this system resulted in increased abundance of annuals and higher levels of species richness in the summer plant community but resulted in an increase of only one species of annual grass. Higher levels of summer precipitation may be required to observe responses by perennial grasses to fire in this community.

The widespread desertification that has occurred in many arid grassland habitats has dramatically reduced grass cover and thus the ability of such systems to carry a natural fire. Re-introducing fire into such systems may often require artificial means as was done in this study, and thus interpretations of the generality of our findings requires caution. However, despite the artificial nature of our burning treatment, the plant responses observed in this study in response to burning were similar to plant responses in arid grasslands following natural fires (e.g. Ahlstrand, 1982; Bock & Bock, 1992). Additional work is required to compare the effects of artificial *vs.* natural fires in shrub-invaded arid grasslands.

We thank J. Brown for thoughtful discussions and permission to work at his long-term study site. We also thank J. Bogard, C. Jacobi, S. Nordell, and J. Roback for help with burning, and Q. Gou and N. Huntley for help with plant identifications. This study was supported by National Science Foundation grant DEB 9221238 to J. H. Brown and by several California State University, Northridge institutional grants to T.J.V.

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A Review of

FIRE MANAGEMENT IN THE KAKADU NATIONAL PARK
- THE ECOLOGICAL BASIS FOR THE ACTIVE USE OF FIRE*

in relation to

FIRE MANAGEMENT NEEDS IN KOSKCUISKO NATIONAL PARK

Review by R. W. Condon - January 1988

The above paper on fire management in Kakadu National Park mentions the deliberate use of fire with the object of preserving or manipulating major habitats - "with the hope that animal species will be conserved by preserving habitats or plant species".

This is a refreshing attitude to fire and, although fire in the Top End of the Northern Territory is of much greater frequency than sub-alpine areas of New South Wales and Victoria, the positive use of fire by National Park authorities has important implications for the management of national park areas in south-east Australia.**

Press discusses and illustrates the assumed fire patterns in pre-Aboriginal and Aboriginal times in open forested woodland and compares this with the contemporary fire patterns (from Braithwaite and Estbergs, 1985). The Northern Territory has a dry season commencing in April and continuing through to November-December when the tropical monsoon rains begin to arrive.

In pre-Aboriginal times, fires were ignited by lightning and did not occur until October-November, presumably as the frequency of dry electrical storms increased in these months. The pattern was identical in both woodland and open forest, both communities carrying a heavy load of tall

* A. J. PRESS (1987) - "SEARCH" - 18:5:(244) - September-October 1987.

** It is interesting to note that there was a spate of fires in south and south-east Australia in the period 5-12 January 1988. Virtually all of the fires in South Australia originated

tinder-dry grass fuel towards the end of the dry season.

Aboriginal use of fire in the open forest areas commenced in June, reached a peak in July and ceased in September. A small percentage of fires occurred in November-December, presumably as a result of lightning strikes on unburnt country, but contained in area because of the earlier extensive patch burning. In the woodland vegetation communities, Aboriginal use of fire commenced in May, reached a long plateau from July to November and tailed off to nil in December. Press does not discuss the reason for the different fire patterns in the two communities.

Press reports that "about 80 years ago, the fire regime changed" due to reduction in the number of Aboriginal people and the development of the pastoral industry. In the open forest, fires commenced in May, working up to a peak in September (between the Aboriginal and pre-Aboriginal peaks in July and November respectively). In the woodland, fires commenced in April with a peak in June and a secondary peak in August, tailing off to nil in November.

Press reports that the Plans of Management for Kakadu N/P lists fire as one of the most important of the immediate management aims for the Park - the aim of the fire management programme being to "re-establish ..... the presumed pattern of traditional Aboriginal burning. The Australian NPWS is using control burns to achieve the aims of its fire management programme ..... in order to: - "

- break up the country into smaller management units
- to protect fire sensitive habitats (from wildlife).
- to reduce fuel loads over large area
- to limit likely sources of ignition in the late dry season
- to limit the spread of late dry season wild fires
- to secure the Park boundaries from incursion and excursion of fires
- and, to produce an array of fire histories in the park.

It is noted that the traditional owners of the Park also undertake fire management in areas used by them for living, hunting and gathering.

In discussing the relationship between fire and flora and fauna, Press describes the adaptations which plants, particularly Eucalyptus (but also a range of other tree species) and grasses have to enhance their survival under a regime of regular burning.

In discussing fire effects on habitat, Press reports that long-term studies have shown that marked changes in vegetation structure occurred in woodland and open forest subjected to differing fire regimes in small plots. Frequent high intensity fires lead to elimination of the mid-storey (shrub) layer, the species of which persist as a ground layer.

Bowman (1987) reports that fire in northern Australia changes structure but not species composition and that "despite the frequency of fire, forest communities are geographically stable. Some grass species can be removed by burning in a particular season."

Fire in the surrounding areas can be used to keep frequent wild fire out of monsoon forest which would allow entry of grasses and weeds.

In respect of fauna, although early dry season fire removes 90% or so of the bio-mass, the result is a 4 to 5-fold increase in crude protein levels which encourages grazing fauna especially kangaroo and similar species. Running fires, of course, are used by many bird species feasting on the insects flushed out by the fire while others feed on the burnt area.

Press has a diagram showing the factors influencing plant habitat such as soil conditions, nutrients, water regime and natural disturbances. He points out that only two of these influences can be manipulated by land managers - fire and feral animals, the latter in northern Australia being the buffalo. (In Koscuisko, the domestic grazing animals could serve admirably as the manipulative influence.)

"The Australian NPWS is aiming to re-establish the form of traditional burning practices on the Aboriginal people" to ensure that areas of the park are subjected to a number of different fire regimes on a large scale.

Press concludes with a statement that "fire regimes to which the land is subjected must be varied" and this variation must be spatial as well as seasonal. As our knowledge from research increases, "fire management techniques must be refined in order to achieve specific management goal".

(There would appear to be lessons here for park managers in southern Australia where the population is too far removed from its roots in the land to appreciate the place of fire in the environment and hence too fearful of the effects of mild fire to use it to conserve the environment in a near-natural state. Instead, our environments intended for conservation are being turned into unnatural environments by a popular fetish for preservation -- and are being placed at risk from catastrophic wildfire.)

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FERAL ANIMALS ANDS NOXIOUS WEEDS
IN THE KOSCIUZKO NATIONAL PARK

by Dick Condon, rangeland and
environmental consultant
October, 1987.

The following notes were compiled following an inspection of the central eastern portion of the Kosciuzko National Park, in the area generally westerly of the Eucumbene Dam.

Then inspection was in company with Peter Cochrane, Fire Control Officer for the Snowy River Shire Council(also with a grazing property at Yaouk in the area north-west of the Eucumbene Dam) and Jim Commins, then President of the Mountain Cattlemen's Association of Victoria

It discusses the situation in relation to feral pigs, brumbies and rabbits, and noxious weeds in the Park, anf the implications in respect of the then proposed Alpine National Park in Victoria.

A copy would have been sent to Jim Commins at the time.

FERAL ANIMALS AND NOXIOUS WEEDS.

The inspection revealed some serious feral animal and noxious weed problems which have developed since the snow lease grazier was moved off the snow summer grazing grounds in 1957 and replaced by the negative management approach to these problems by the former KSP Trust and the NPWS. These problems relate, of course, to the lack of financial resources to provide the manpower to control problems which were kept under reasonable control by the graziers. These problem areas are discussed briefly below.

A. FERAL ANIMALS.

1. Feral Pigs.

Evidence of feral pig rootings was seen throughout most areas of the sub-alpine grasslands. By the time the magnitude of the problem had been realised it was too late to start counting but it is estimated that there would have been some 50-80 sites disturbed by pigs (counting groups of several sites in close proximity as one site).

Most of these were sites disturbed last summer, with some freshly disturbed since the snow melt and only a rare site older than twelve months. The evidence suggests a rapid explosion in the pig population in 1986 - 87. (What were the seasonal conditions in 1986-87? Were the pigs short of traditional food and therefore resorting to rooting for food - discuss with John Rudd) ≠ 7

The pigs operate by using their snouts to turn over the sod of the (mostly senescent) snow grass leaving bare areas about 30 X 60 cms separated by areas of similar dimension untouched under the turned over sod. In some cases the disturbance covers 70-80% of the disturbed ground. (See photos - Coolamon Homestead Numbers

≠ 7 - Discuss with John Rudd.

their presence the inspection party did not see one feral pig in three days of travel.

It will be a most ironic situation if the snow lease graziers were moved off their mountain grazing leases because of what was seen to be a minimal risk of erosion at sub-alpine levels, only to have a serious and real erosion problem promoted by feral pigs which the snow lease graziers would keep under control in their own interests.

It is seriously suggested that the most effective way to keep feral pigs at reasonable levels would be to make it worthwhile for snow lease graziers to come back into the sub-alpine areas. The benefits to nature conservation and natural values would be even greater.

The disturbed areas range mostly up to areas of 3-5 metres square although occasionally areas of 100 square metres may be so disturbed. These are often on steep slopes falling down to a river or stream or at the foot of steep but small convex slopes. Although most obvious in the sub-alpine grasslands, some examples were noted in snow gum woodland and near the lower tree line (see photo

It was reported that there were large areas effected on steep slopes opposite the former Happy Jack's village site with rootings covering an area of approximately 200 acres with at least one-third of this area being dug up. This area was observed some three or four years ago and has since been well colonised by sorrel (Rumex acetosella) and other mat-forming herbaceous species. It is expected that a close inspection would probably reveal many areas eroding under the effects of frost heave where the slopes were steep.

On the areas other than at Happy Jack's, obviously disturbed in 1986-7, there has been no sign of colonisation which would normally be by prostrate herbaceous plants. On the only older site seen, colonisation by prostrate herbs was taking place around the edges but any area more than 30 cms square was exhibiting frost heave effects towards the centre (see photos number

This was on an almost flat slope on which the plants would eventually win. But this would not be the case on steep slopes and such areas would be expected to expand by erosion as frost-heave made it impossible for the colonising plants to establish.

Had the snow lease graziers still been on their mountain runs, a feral pig problem would not have been allowed to develop. As an example of attention to this problem and the nature of the problem, one grazier in the Snowy Plains area reported shooting over 350 pigs over a period of ten years on his property and in surrounding areas of the KNP.

Given a few more years, erosion initiated by feral pigs will be many times worse than that claimed to be caused by cattle and sheep grazing in sub-alpine grassland areas. Effective control by the KNP will be very expensive whether carried out by shooters in vehicles or helicopters, or by trapping and poisoning. In spite of the widespread evidence of

No. 2. Brumbies.

Brumbies occur in some areas of the Park, particularly in the Tin Mines area south of the Alpine Way where they have been for many years. Evidence of their presence was seen on the Botheram Plain area (within the park) where, with the help of a recent fire (8/82) and a moderate rabbit infestation, they were helping to maintain species diversity and the wildflower population by preventing the snow grass from senescing.

In this way, they probably serve a useful purpose in the areas they inhabit heavily enough, keeping the snow grass fresh and vigorous in the vicinity of tracks and bushfire trails and thereby making these more effective as fire breaks and lines from which to carry out bush fire burning operations or back burning operations in the event of a wildfire. However, there is no control other than occasional culling and it would seem much better for park values generally if they were replaced by cattle grazing with some degree of control as to time, place and degree of grazing, with specific objectives in view.

3. Rabbits.

Researchers, and presumably others, are just waking up to the presence of rabbits in the KNP and are finding reasons to put them under close study.

It is usually conveniently, forgotten, of course, that rabbits were in large numbers in the lower areas of the sub-alpine grassland and woodland in the pre-1950's and would no doubt have contributed greatly to any erosion which may have been present at those times.

The party saw evidence of the presence of rabbits in light numbers in dung hills, in places with warrens and recent control measures (baiting only - no ripping) in the Botherum Plain area. Here, however, they were combining with the brumbies and a recent burn (8/82) to maintain the sward in a condition to support a good stand of wildflowers in the January-February period.

Again, it would be preferable to have rabbits under control or preferably eliminated, and replaced by controlled sheep and/or cattle grazing with specific objectives in mind. The livestock owners could also be responsible for rabbit control - as well as control of feral pigs, feral dogs and horses.

Continuation of

Feral Animals and Noxious Weeds.

A. Feral animals - see elsewhere.

B. NOXIOUS WEEDS.

There are two noxious plant species which should be causing concern in the KNP - blackberries and St. John's Wart - both in fringe areas of the park at lower elevations.

(1) Blackberries.

Large patches of blackberry are becoming established on formerly cleared country adjacent to the Murray River opposite Tom Grog station. Photo number shows some of this spreading infestation which contrasts with the similar country on the Victorian side of the river.

Hundreds of acres of Blackberries also occur along the course of Wallace's Creek and the Lower Yarrangobilly River near Ravine on the Tumut River being the area severely burnt in the March 1965 bushfire.

In this, and probably similar situations in lower levels, it would be replacing the native Tea Tree (Leptosperma villosum?) which provides a fringe community along the small creeks in forest areas.

One thing is certain - blackberries will continue to increase at an alarming rate unless something is done to bring them under control. Chemical control of large infestations is expensive and needs to be repeated many times. The most effective way of eliminating blackberries is to use goats - but the areas would need to be securely fenced. This would not be impossible in the generally gently sloping valley bottoms alongside creeks in forest areas and at Tom Grogin. In the latter case, consideration should be given to selling off this relict area of cleared country presently within the park so that it can be managed in accordance with its partly developed condition.

(2) St. John's Wart.

This very noxious weed is reported to have spread widely over the cleared areas along the eastern foreshores of Blowering Dam. In this location, on each side of the Snowy Mountain Highway, it is ideally situated to be carried further into the Park by vehicles. However, as with new species, it would probably have difficulty in becoming established in forest and plain areas except in disturbed sites.

There are some hundreds of acres in the Blowering foreshores area which need bringing under control - a major job for a Departmental organisation with land management responsibilities. ≠ 7

≠ 7 Check with P. Cochrane's.

(3) Other Non-Native Plants.

Apart from an occasional plant of Scotch broom which has taken over much sub-alpine woodland country in the Barrington Tops National Park north of Newcastle, the only non-native plant noted by the inspection party was sorrel (Rumex acetosella). This is a small prostrate herbaceous plant which does an excellent job as a primary coloniser on bare ground or disturbed or denuded areas (especially that disturbed by feral pigs). It plays a typical colonising role and is the first step in a succession to a "pasture" community and dominated by the native snow grass. Many of the soil batters on roads in the KNP owe their stable herbal/grass cover to the sorrel's vigour as a primary coloniser.

White clover occurs occasionally in former stockmens' huts horse paddocks but is now mostly inconspicuous. It occurred as an excellent pasture in an area on the Snowy Plains taken over by the KNP about ten years previously (see photo). The clover has largely disappeared as the superphosphate has been withdrawn and as the snow grass has resumed dominance - a story similar to the former sheep camp on Bald Mountain (see page)

≠ 8 Contact P. Cochrane - when taken over by KNP.

≠ 9 Contact Roy Hedges - also re ≠ 8.

G. IMPLICATIONS FOR VICTORIAN HIGH MOUNTAIN COUNTRY.

The findings on the present state of the "natural" environment in the sub-alpine regions of Kosciusko National Park after 30 years of freedom from grazing livestock and no fires emphasises the need to re-think the Alpine Area Planning Proposals in respect of phasing out cattle grazing in the areas proposed as National Parks. To be ~~colonised~~ as such. It will remain an environmental disaster as ecological des ert until the areas presently overgrown with standing snow grass hay are visited by fire. Ideally this should be by prescribe burn designed to rejuvenate the alpine grassland vegetation before it is too late for many of the minor species. However, any artificial use of fire is fraught with enormous risk of creating a wide spreading wild fire unless very carefully managed.

If a wild fire ignites on a blow up day, or is already burning when such a day arrives, the result will be another environmental disaster with the added threat of widespread erosion and heavy silt loads in streams. It can only be hoped that the conservation movement will then be prepared to accept the responsibility for the outcome in view of its influence on park management based on protection and preservation.

In the Victorian highlands, if the cattle are phased out, the greatest loss will be of the alpine flowers which, from all accounts, occur widely in areas not grazed until late in the season. It is unfortunate that the community and the governments have been hoodwinked into believing that removing the cattle and protecting the environment from all man-induced influences will encourage floral displays and somehow save these and the endangered species from extinction.

From the experience in Kosciusko, it can be predicted, with a reasonable degree of certainty, that if the cattle are taken out of the Bogong High Plains and other areas in the Victorian Alps and the ban on the use of fire continues, there will be several detrimental effects on the natural environment.

In areas now dominated by snow grass with a good sprinkling of alpine flowers, the snow grass will continue growing with its usual vigour each year and within 8-10 years will have completely shaded out all the herbaceous species so that wildflower displays will be a

rarity if they happen at all. The stultification by senescent snow grass will be worse in sub-alpine areas where there is much less variation is habitat as a consequence of aspect and other effects on local climate.

There will be little or no change in the bog communities other than those induced by climatic changes. If the climate becomes drier, the bogs will become drier, the small streamlets will silt up and the flow velocities slow down and their courses will be filled with water plants. If the climate becomes wetter, the bog communities will be invigorated and the entrenched streamlets will become more headlong.

In areas dominated by heath, the shrubs will grow taller and thicker in the centres of the shrub invaded areas and spread out around the fringes, gradually occupying larger and larger areas. Many areas will become impossible to walk through in summer.

In the absence of grazing, the risk of all-destroying wildfire will be greatly increased - ignition from lightning strikes made easier, and the intensity of any fire greatly increased because of increased fuel loads and increasing flammability.

If long term research results apply on the broad scale, we can expect some species not able to withstand grazing to reappear. As against this, species which need fire or other disturbance to maintain themselves, especially the minor herbaceous species, will disappear.

It can be expected that the occasional small areas suffering from severe erosion will be colonised and eventually stabilised by shrub species on areas which are not too steep.

It needs to bw appreciated that the present grazing, even in its present primitive form with little positive management because of the lack of reasonable tenure, does provide a range of grazing pressures rom heavy to light to nil. Areas not grazed will continue to be ignored (unless the excessive trash is removed by fire). This variation in grazing pressures ensures that there is plenty of diversity in the sub-alpine and alpine grassland and woodland communities. This diversity will be lost if grazing is phased and its beneficial effects not replaced by using mild fire as a substitute for grazing.

Another scenario can be considered. The present regime can be continued to maintain the many eco-systems in their present vigorous condition. Carefully designed patch-burning can be undertaken to rejuvenate areas of senescent snow grass before the minor species waiting for their natural expectation of fire become locally extinct as the seed source loses viability.

Areas which contain species recognised as rare or endangered can be fenced off to see whether protection does what is expected of it. But the authorities should be prepared to introduce mild fire if snow grass senescence becomes the dominant trend.

The occasional area suffering from severe erosion can be fenced off to encourage colonisation of such areas by shrub species.

A further scenario again can be considered. The regime outlined above can be considered and the area proposed for national parks status can be proclaimed as such, but the place of cattle grazing and patch-burning recognised as essential elements of the eco-system - and the right of the cattlement to continue occupation written into the legislation. Such legislation could also recognise the cattlemen as living heritage - a surviving remnant of a way of life and endeavour on which Australia as a nation was built. Victorians would then not need a Stockmen's Hall of Fame to remind its citizens of the debt Australia's nationhood owes the pastoral industry of the 19th century.

This, of course, will require a process of re-education of the community to the effect that the Clementsian theory of succession of plant communities to a stable climax does not happen in the Australian scene except in a very limited number of environments. It would require a positive approach to the teaching of ecology in schools so that the subsequent generation of adults will have a better understanding of ecological principles and processors than the present community imbued with the concept of protection and preservation which puts nature in an ever-tightening straight jacket.

The vocal minority in the conservation movement will be shocked but there may be enough people of goodwill in that movement to recognise that our natural environments need positive management if they are to be maintained as such.

THE APPLICATION OF RATIONAL(=CELL)-GRAZING IN THE MOUNTAIN GRAZING ALLOLTMENTS IN THE HIGH COUNTRY OF VICTORIA.

By Dick Condon. Rangeland and environmental consultant .

The several pages following discuss a proposal developed in association with Jim Commins (now deceased) of "Araluen" via Ensay in the Omeo region of Victoria for a rational grazing program on his Mountain Grazing Allotment

The first several pages discuss general and descriptive aspects of the montane forest environment, especially in relation to grazing and fire. This is followed by an appraisal of "A new approach to the use of Mountain Grazing Allotments", with an outline of the present "paddock" arrangement and the possibility of further sub-division to create a total of six paddocks. It also discusses how the level of grazing for each of the paddocks might be determined in an experimental approach.

It then discusses management objectives and tenure considerations.

It is appropriate to mention that Jim C. was familiar with the concept of rational grazing following contact with a Kelley Sullivan who had done the Savory HOLISTIC RESOURCE MANAGEMENT Course un USA. Jim C. was also aware that the writer had also done the course and had invited him to Araluen to exchange ideas on the concept.

The following notes would have resulted from that exchange of ideas.

The item from "The Voice of the Mountains" (No. 13. 1990) immediately hereunder Shows that Jim Commins had a very close understanding of the concept of Holistic Resource Management and of the origins of the Australian continent and the adverse effects of the absence of hard-hoofed animals.

THE MISSING LINK

Hard-hooved animals and the Australian environment

Many people have strained credibility by claiming that so-called soft-footed animals have less adverse effects upon soil and water conservation values than do 'hard' hooved animals.

It is difficult to support this theory after observing the extensive areas of bare and disturbed ground scarified by lyre birds beneath the scrubby understory of forests in the Eastern ranges and the burrowing and soil subsidence following countless years of wombat excavation.

Half a century ago there was vast devastation by soft-footed rabbits that completely denuded the land, destabilized river banks, and ring-barked millions of tree seedlings.

The inconclusive rhetoric that has been circulated and has gained some currency with people who do not understand grazing animals, has led them to believe that the so-called hard-hooved animals are detrimental to the Australian environment.

Australia appears to have had by far the greatest soil erosion rate of any of the major land masses on the planet Earth and yet it is the only country that has not had vast herds of grazing ungulates. History indicates that in other countries, great herds of these hooved animals generally moved in a migratory fashion as they followed seasonal pasture growth and had their herding instincts developed by predators.

As they moved across the land, their hoof and tooth action reduced most of the remaining previous season's brittle and combustible dead grass to composting litter and converted new growth to fertilizer. Unfortunately human intervention with animal management has not always been accompanied by good husbandry practices in various parts of the world and this has created the misplaced belief that hooved animals are all bad for conservation values.

In Australia, where geologists have informed us that in past ages mountain ranges were as high as 25,000 feet above sea level, the large land creatures other than birds were marsupials and reptiles. Most grazing marsupials avoid the more elevated and snowy regions but it appears that as the mountains eroded and the plains became more arid and the annual snow melt reduced, these animals developed a unique reproductive system that better equipped them to survive droughts.

Until the aboriginal race of humans, and dogs came (a short space of time in ecological terms) their survival instincts were directed rather to withstanding drought than to the depredations of large and effective land based predators.

For millions of years the high country of Australia which is derived from the same basic foundations as are to be found throughout the rest of the world, was affected by successive routines of fire, flood erosion and regrowth which continued with relentless and devastating effect.

The average elevation of land in Australia is probably less than 200 metres while all other major land masses would have an average elevation of perhaps 1,000 metres or more.

There is a very great difference in the erosion levels while the only real significant difference is that Australia has not had the same beneficial hoof and tooth action of vast herds as they followed the seasons and made the annual regrowth of ground cover less fire-prone.

There is ample evidence today that well-managed grazing activity uses, and at the same time, strengthens plant communities of pastoral value.

In conclusion, is it not a fair question to ask, has the lack of hooved animals been responsible for accelerated land degradation in Australia?

Jim Commins

"VOICE OF THE MTNS" No. 13/990

J. COMMINS "ARALUEN"-MOUNTAIN GRAZING ALLOTMENTS.

The Commins brothers hold two MGAs, one centred on Quinns or Nunniong Plain and north to Reedy Creek and on the east approximately bounded by Bentley's Plain Creek, the other generally to the east of that, taking in the headwaters of Mellickenie Munjie Creek and Mia Mia Creek and Timbarra River.

The area served by several forest roads with access from the south by the Little River road (past the Araluen homestead) and Bentley's Plain road - and from the east up the Tambo River valley to Junction Creek over the Nunniong road, the latter later becoming Nunnett's road after heading north east towards Blue Shirt Hill and then swinging SSE along the ridge between the Timbarra River running SSWly into the Tambo and the Buckan River running south to the Buckan and joining with the Snowy River.

The MGAs total 35,000 acres (14,000 ha) being mostly tableland plateau at around 4,500 feet plus or minus 500 feet, carrying a dense poor quality forest of snow gum (Sng) at 2-10 metre spacings with some at 1-2 metre spacings with small areas of mountain gum and occasional alpine ash in lower areas with an easterly or southerly aspect.

Black Sally forms dense small forest at 1-10 metre spacings along the boundaries of the small "plains" which occur occasionally.

The soils are derived either from basalt (in the Quinn's Plain area) developing a rich black friable clay with sweet feed and, very attractive to cattle, or from a conglomeritic basalt material which tends to remain large gravelly at shallow depth below a medium brown clay loam surface(Brumby Rock area overlooking Reedy Creek) or an indurated shale forming a dark brown clay loam.

In earlier days,grazing animals and rabbits had congregated around the sweeter feed on the Quinn's Plain area causing this to become seriously eroded with a grazing pattern somewhat like that of a type typical of the sacrifice areas in semi-arid regions.

In order to protect the plain area and encourage livestock onto other country, the plains area had been fenced off about 30-40 years ago to enclose an area of about 600 acres. Other fences have since been builtto enclose an adjoining area of about 1,200 acres. Other fencing is needed further out to prevent

cattle placed in outlying areas from gravitating back to the sweeter basalt country.

Mr. Commins estimates that, of their own volition on present fencing, cattle would only use about 20% of the area covered by the two MGAs totalling 35,000 acres. Thus actual grazing is limited to about 7,000 acres. With a grazing herd of about 850, this represents a grazing rate of 1 beast per 8 acres ranging from about 1 beast per 2-3 acres (1bpha) in more heavily used areas to 1 beast per 20 acres or more in lightly used areas.

The Commins MGA's are much more easily accessible to livestock than most with the exception of areas like the Bogong High Plains which are largely freehold forest and woodland and of gently undulating to undulating topography.

This being the case it would appear that effective utilisation of MGA's would range from 10% up to 40%, with the majority remaining largely ungrazed other than by brumbies (which likewise restrict their activities to favoured areas).

This is a near-ideal situation for the concept of species and community diversity, providing a range of grazing effects radiating out from the most favoured locations, but leaving the greater part of the country untouched and therefore at risk from senescence, undesirable succession to shrub understorey and smothering with leaf and bark litter and, eventually, the holocaustic effects of widespread wildfire.

The presence status of the areas affected by various intensity of use are discussed below following the notes on the recovery of the severely eroded area under the headings discussing deleterious effects.

These aim to describe the various processes operating under the present regime with a view to better understanding as a basis for the development of a management prescription.

Recovery From Severe Erosion.

Mr. Commins advised that in earlier days the basaltic soil on Quinn's Plain became severely wind eroded as rabbits kept the grass bare, stock were always on it in high numbers and brumbies came to roll in the soft bare soil. In a couple of places of 50-100 metre dimensions, from 30-60 cms of soil have been blown away, leaving large stones exposed at the surface. In other places smaller areas had lost 10-20 cms of soil over areas of 20-50 metre dimensions.

Because of the severe erosion by livestock and rabbits, Mr. Commins fenced out about 600 acres (240 ha) of Quinn's Plain to keep livestock out. Myxomatosis dealt with the rabbits from about 1950 and since that time the severely eroded areas have been recovering and are about 95% covered with Sng and low growing forbs.

Regeneration has taken place in polygon like areas leaving narrow strips of bare soil, about 10 cms wide, frost heaving mildly. The extent and depth of previous erosion is obvious in the boundary areas from the difference in levels between uneroded and eroded soil surfaces. (3 or 4 colour pictures were taken of the recovery including a close up and showing a 60-80 cm difference in level.)

Deleterious Effects to Natural Environment of Non Grazing in Grassland Communities.

In another area, in an open woodland site, with trees at 10-20 metre spacings with small natural clearings, a forester doing a research thesis had arranged for Mr. Commins to fence in a small area about 30 metres by 15 metres. Most of this was rabbit proofed but another small area was open to rabbits (and probably wombats) but difficult for kangaroos.

The contrast with the heavily grazed area outside the enclosure was most marked. Inside, was moribund Sng providing a complete cover but the whole laid over with a dense mat to 5-10 cms depth of dead Sng foliage. The area available to rabbits was similar but slightly lighter and showed evidence of mild but uniform disturbance (probably by wombats rather than rabbits), there being slightly less dead foliage.

There had been plots with various fertiliser treatment but there was no discernible difference in the non grazed situation - indicating that the addition of fertiliser had very little lasting effect on the environment.

Outside the enclosure, the native herbage formed a close sward or turf with snow grass cut level with the sward surface and fresh and green, although to this point it had made little growth. Small plants of snow daisy were germinating and they were 7-10 other herbaceous species in each square metre. These would make vigorous growth from now on*, along with the snow grass.

*September, 1987

Although the area would have been heavily used by livestock and native animals there were no signs of overgrazing or opening up of the sward by erosion, only a healthy close -cropped (although no grazing other than by brumbies since last April-May).

Several photos were taken of the exclosure and surrounds.

Other effects of non-grazing were seen alongside the many formed roads in the area. Brumbies, which were able to graze the area throughout the winter months, kept the snow grass on the road pavement, table drains and verges eaten down to a flattish tussock with well chewed off foliage to about 5cms in length making a tussock of about 10 cms diameter and 3-5 cms in length.

In such areas, this provided sufficient cover to protect the soil surface from the effects of needle ice and freeze-thaw conditions with snow grass plants

lying alongside each other and only small spaces of 2-4 cms between. The Sng was healthiest on the cuts (on both sides of the table drains) where the surface horizon "outcropped" orwhere surface soil had been spread over the verges.

There was not much species diversity on the regenerated plant community on the cut and fill road verge and road surfaces but this increased into the less disturbed road verges out to the pile of timber pushed up as an elongated log pile about 5-10 metres out from the table drains.

However, beyond the log pile, in the area virtually "fenced off" from the brumbies, the snow grass community was moribund and senescent like that in the exclosure,with a 3-5 cm mat of dead foliage overlying everything and herbaceous species conspicuous by their absence or occasional presence.

Deleterious Effects in Forest Areas.

Snow gum stunted forest occupies the greater parts of the MGA's with intensity of grazing use ranging from mild in areas close to woodland and plain areas, to very light in areas further away, to nil in areas remote from the above or on precipitous slopes. If they need to, cattle will use quite steep slopes up to 20-30% but unless the feed areas is sweet, they need to be forced onto such areas by denying more favoured/with strategic fencing.

This variation in intensity of use results in a range of effects on the forest floor, individually and on the small scale, desirable in relation to natural values but, because of their extent, undesirable in relation to the total landscape. These effects are discussed below, in relation to the use of the snow gum stunted forest floor environment as distinct from woodland and grassland environment.

The snow gum stunted forest ranges from dense regeneration stands at 1 metre spacing or less, amongst other trees at 3-10 metre spacings, to older communities at 3-5-10 metre spacings, this being the general condition, with small areas of open forest or close woodland with larger trees at 5-10-20 metre spacings. The black sally tends to become dominant in the zone adjacent to frost hollows with taller mountain gum forest at lower elevations below 1300 metres.

(a)Moderate Grazing Use.

The forest floor in these areas is relatively free of shrubs, the ground vegetation being dominated by snow grass with a good sprinkling of herbaceous species forming an open turf. Leaf and bark litter occupies about 50% of the surface or less, except in heavily barked areas within a metre or two of the trunks of the larger trees. Snow gum bark tends to fall off in moderately small pieces and strips and does not form as heavy a build up at the base of the trunk as ribbon-barked species.

(b) Lightly Grazed.

Small shrubs at 1-2 metre spacings to $\frac{1}{2}$-1 metre high tend to dominate with the ground sward being more open in terms of occupation by snow grass tussocks at 10-20 metre spacings between centres giving a tussocky sward in which the herbaceous species are struggling for light and space with the over burden of dead snow grass foliage.

(c) Non-Grazed Areas.

There are several types of situations depending on time to a previous fire but including the following:-

(i) Small shrubs, dominant at 1 metre spacings with leaf and bark litter smothering the snow grass (and herbaceous plants) so that snow grass plants are 20-60 cms apart apparently being forced out by either shrubs or leaf and bark litter accumulation.

(ii) Leaf and bark litter dominating the forest floor with only a sparse representation of snow grass and forbs, these becoming dominant in small areas.

(iii) Areas long unburnt present a tangled mass of small, long-dead branches and trunks to 20-30 cms off the soil surface, with leaf and bark litter forming a deep mat to 5-10 cms with a light snow grass foliage diffused through the mass. Light or heavy fallen trunks also occur and the total makes a very dangerous fuel type.

Considerations in Respect of Wildfire and Natural Environment.

The latter areas particularly represent a serious threat to the extensive commercial forest areas to the southeast (Nunnet State Forest?) in the event of fires becoming established under moderate conditions and developing over a period to extreme conditions. In this situation the height and intensity of the flames will do much damage to the snow gum which (in the woodland form at any rate) is easily killed by intense fire.

In this situation, the ease of ignition by lightning strike is greatly increased with increasing depth of leaf and bark litter on the forest floor.

In addition to the increasing risk of extreme wildfire emanating from or working through such areas and destroying natural values on a large scale, there is a decline in natural values because of gradual disappearance of the lesser species from the forest floor community as the physical and chemical and biological effects of increasing leaf and bark litter dominate the forest floor environment.

The processes involved in the decomposition of leaf and bark litter and its incorporation into the soil operate more effectively under (or in association with) a grass sward than in the situation in which leaf and bark dominate the soil surface environment. The incorporation of such organic matter into the soil and the process of re-cycling of plant nutrients would take place much more readily under a grass regime in which stock trampling helps in the incorporation process or the material is returned to the soil as manure.

HRM APPROACH TO THE USE OF MOUNTAIN GRAZING ALLOTMENTS.

The possibilities of developing a rational grazing programme on MGA's held by Jim Commins and his brother was discussed with Mr. Commins along the following lines.

(1) Present Grazing Areas.

Mr. Commins estimates that the 850 head of cattle which currently use the two adjoining MGA's would presently, of their own volition, only use about 20% of the total area. This means that they would use only 7,000 acres at an average grazing rate of about 1 beast per 8 acres with a range of grazing rates from 1 beast per acre to 1 beast per 20 acres. With the 600 acre paddock around Quinn's Plain and the adjoining 1200 acre paddock in the south west corner and further fencing to create a further1200 acre paddock at the south end, and in more remote areas, it would be possible to establish six "paddocks" over the 2 MGA's, ranging up to 4,000 acres in area over a total of about 13,000 acres.

Distribution of the present herd of 850 over this area would give an average grazing rate of about 1 beast per 15 acres with a probable range of 1 beast per 10 ha to 1 beast per 20 ha with small areas more heavily grazed and probably much of the large areas not grazed at all. However, there has been no erosion, or pasture degeneration, as a result of present levels of grazing and management and it would be reasonable to double the present grazing capacity without any ill effect. On a continuous grazing basis, over four months, it would be reasonable to accept the present rate of 1 beast per 8 ha for country which is actually grazed by cattle in the mountains under the rainfall conditions applying in the Nunniong area.

(2) Further Sub-Division.

As cattle are forced out into more outlying areas, they tend to work back towards Quinn's Plain and/or the road leading home to Ensay. The only risk would be the tendency for some to follow the Nunnett road down to the State Forest area to the south and south east.

It would become necessary to put a grid across the road at a spot where it is steep enough to discourage the cows from walking off the road when they come to the grid.

The first subdivision will follow close alongside Nunniong road, virtually within or adjacent to the road clearing, using existing standing timber (for the most part) to hold the wires. Ideally the fence should be electrified to reduce cost.

The northern end of the western MGA is bounded on the north by the Reedy Creek Gorge which would be an effective barrier to cattle. But there is one complication in that the Alpine Area Planning Proposal (AAPP) has included a strip of country at the southern end of the number 4 ɔbberas p/u of the AAPP to take in the catchment of Little Reedy Creek which runs parallel to the Reedy Creek Gorge. This is supposed to have some unique vegetation community although there is no mention of this in the AAPP or of the reason for the proposed Alpine National Park status although this could be hidden in the final paragraph uner "Major Features" on page 40 of the AAPP.

Another fence would be run in a north south direction across the upper end of the Blue Shirt Creek valley. This fencing would be sufficient to give a total of 6 paddocks including Quinn's Plain.

A Proposal for Rational Grazing on the Nunniong MGA's.

Table 1 below lists the paddocks and the estimated areas of the 6 paddocks which could be brought into a rational grazing programme if the proposal proceeds. The names in column 1 are provisional. In column 3 is an estimate of the grazing capacity of each "paddock" using the Quinn's Plain paddock as a standard 1.0. Column 4 gives an estimate of the effective areas in relation to the standard of 1.0. Column 5 assumes a grazing cycle of 2 months allowing for 2 grazing cycles in the 4 months that the main herd of cattle will be in the area.

TABLE 1. A DRAUGHT RATIONAL GRAZING PLAN FOR NUNNION MGA.

"PADDOCKS"	AREA (Acres)	GRAZING FACTOR	EFFECTIVE AREA (ACS)	GRAZING PERIOD (60 days)	REST PERIOD (days)	GRAZING PERIOD (40 days)
Quinn's Plain*	600	1.0	600	4	56	2 (38)**
Mason's Creek*	1200	0.8	1000	6	54	4 (36)
Emu Plain	1200	0.8	1000	6	54	4 (36)
Blue Shirt	4000	0.75	3000	18	42	12 (28)
Timbarra	4000	0.75	3000	18	42	12 (28)
Diggers Hole	2000	0.70	1400	8	52	6 (34)
TOTALS	13000		10000	60	42-56	

* Existing Paddocks ** Rest periods shown in brackets.

The grazing periods are determined by the proportion of the effective paddock area in relation to the total effective area of 10,000 acres multiplied by the 60 days of the grazing cycle. The rest periods are the difference between the grazing periods for each paddock and the number of days in the grazing cycle.

Probably the Quinn's Plain paddock would be used as a holding or mustering or/and staging paddock in which case its use should be limited to this purpose with shorter grazing periods and shorter rest periods.

In the event that there are good spring and early summer rains promoting a vigorous growth, the grazing could be shortened to 40 days to enable 3 grazing cycles within the 4 months period. Column 7 in Table 1 gives the grazing(and rest)periods for a 40 day grazing cycle.

CONSIDERATION IN RESPECT OF PROPOSED RATIONAL GRAZING PROGRAMME.

Assessment of Appropriate Grazing Rate.

In the absence of any reliable basis on which to assess grazing capacity under continuous grazing, other than that discussed above, it is proposed that the initial four months of summer grazing have a standard grazing period of 10 days for each paddock. This will enable the grazing pressures over such a range to quickly determine what might be carried safely without stressing the pastures.

On the grazing period established in Table 1 the grazing pressures in each paddock would be constant at (Diggers Creek "Paddock" for instance) 850 head for 8 days = 6,800 cow grazing days (cgd's) on 1,400 effective acres which is equivalent to 4.86 cgd's per acre.

If on the other hand, we have 850 head for 10 days with 8,500 cgd's on each of the paddocks, the stock density becomes as shown in column 3 in Table 2 below.

TABLE 2 STOCK DENSITIES ON SIX PADDOCKS ASSUMING 850 CATTLE IN EACH PADDOCK FOR 10 DAYS.

"PADDOCK"	EFFECTIVE AREA.	STOCK DENSITY. CGD /AC.	SQUARE YARDS. PER DAY	DIMENSION YARDS SQ.
Quinn's Plain	600	14.2	341	18.5
Mason's Creek	1000	8.5	569	23.9
Emu Plain	1000	8.5	569	23.9
Blue Shirt	3000	2.8	1728	41.6
Timbarra	3000	2.8	1728	41.6
Diggers Hole	1400	6.1	793	28.2

The stock densities in column 3 range from 2.8 cgd's/ac in Blue Shirt and Timbarra to 14.2 cgd's/acre in Q/Plain

In column 4 this has been converted to square yards of grazing available to each beast per day by dividing 4840 square yards (1 acre) by the value in column 3. These values range from 341 square yards or 18.5 yards square (column 5) per day in Q/Plain to 28.2 yards square in Diggers Creek to 41.6 yards in Blue Shirt and Timbarra "Paddocks".

The present grazing capacity for the mountain grazing allottments in which 850 head graze an estimated 7,000 acres for 4 months is equivalent to a grazing pressure of

(850 X 120)/7,000 = 14.6 cgd's per acre.

This means that over the 4 months period, each acre will have a cow grazing it for a total of 14.6 days.

Thus, the grazing pressure on Quinn's Plain paddock* (equivalent of 14.2 cgd's per acre over a 10 day grazing period) is really only equivalent to what the whole 7,000 acres of MGA currently available for grazing on a continuous basis for 4 months. This means, in effect, that the grazing pressure which would normally be spread over 4 months is squeezed into a period of 10 days, and then rested for 6 weeks before being grazed for another period of 10 days.

*In Table 2

From this it becomes easy to set out the effects of the short duration heavy grazing (SDHG) in influencing desirable management objectives such as:-

(i) The removal of much senescent snow grass foliage allowing light to the soil surface and providing space for herbaceous plants to establish.

(ii) The incorporation of much of the senescent foliage immediately into the soil by trampling.

(iii) The breaking up of a lot of old cow patts by hoof action, ensuring faster incorporation and recycling of the nutrients therein.

(iv) The breaking up of many of the fresh cow patts likewise.

(v) The breaking up of much of the twiggy material on the forest floor and bringing it into contact with the soil for quicker incorporation.

(vi) Pruning of the edible shrubs to give them greater vigour.

MANAGEMENT OBJECTIVES FOR A RATIONAL GRAZING PLAN IN THE NUNNION/NUNNET AREA.

There are three sets of management objectives to be considered:-

A. Those of the licensee seeking to increase the earning capacity of the allottment on a sustainable basis.

B. Those of the State as represented by the Department of Conservation, Forest and Lands within which there are 2 main objectives:-

(i) Protection of the substantial forest resource in the Nunnets SF area to the east and south east which would be very vulnerable under extreme fire danger conditions in the case of any fire already burning or ignited in the Nunnion area. The management objective will be to reduce to an absolute minimum the likelyhood of a fire burning when extreme conditions develop, or of an ignition by lightning strike, or any other course.

(ii) Protection of and promotion of natural values in a non-natural park situation.

These three objectives A, and B (i) and (ii) and the appropriate management approaches are discussed below.

A. LANDHOLDER'S MANAGEMENT OBJECTIVES.

The landholder's objective is to increase the productivity of the grazing area so that he can carry more cattle on the available area but on a sustainable continuing basis, without degrading the pasture environment in any way and with minimum adverse influence on the natural environment.

Although the normal community attitudes to conservation and production might seem to place these two objectives into juxtaposition, the rational grazing approach to grazing management will make them complementary. Thus objectives A and B (ii) will be conjoined into the one broad spectrum.

The first approach to meeting that objective for the landholder will be to install fencing to enable the cattle to be spread more widely over the MGA, this having the three-fold object of:-

(1) Reducing grazing pressure in those areas especially favoured by livestock(and feral animals such as brumbies and rabbits).

(2) Opening up a much greater area of land to grazing.

(3) Enabling a programme of rational grazing to be introduced which will enable all three principal objectives to be furthered.

As discussed previously, the fencing programme would aim to establish 6 "paddocks" by extending some fences out from the existing paddocks to natural barriers, by fencing along an existing road and by running a fence north/south across the head of Blue Shirt Creek catchment.

Having established the six "paddocks" as grazing areas, the cattle herd will be rotated in turn through the six "paddocks" in either 2 X 60 day grazing cycles with 10 days in each paddock, or a 3 X 40 day grazing cycle with 7 days in each paddock if growing conditions are better than normal.

It is normal to relate grazing periods to the relative productivity of each paddock but the above is an experimental approach and will give a wide range of grazing pressures in the first year which will enable a selection of a safe grazing pressure on which to base the final rational grazing programme.

In order to make effective use of the grazing potential and to attract cattle into areas which they would not otherwise use, there will be a need to use mild fire in a patch-burning technique on small areas. These would be lit on days on which the fire would normally go out at night burning down hill with the wind or up hill against the wind, initially on gentle slopes to form a protective pattern. In subsequent years, when the protective pattern has been

established, mild fires can be run over steeper slopes, burning down slope in heavy fuel loads after patch burning the ridges and small summits.

In addition to promoting the productivity of the pastures, the prescribed burning programme will be removing much of the threat to the huge area of forest country to the south east and providing a base from which grazing can thereafter keep the fuel load down by maintaining a snow grass sward to hasten the decomposition process for leaf and bark litter.

Such an approach will also restore the environment to something like the pre-European environment in which Aborigines carried out mosaic patch-burning, promoting also the diversity of species and vegetation communities in a range of post-fire successions.

The Forestry Commission will understandably be sensitive about anyone lighting fires on the windward side of the major forest resource in Nunnett's SF. The burning programme, over a period of about 5 years?, should therefore be planned in conjunction with the Forestry Commission and the Commission involved in the burning programme at least in the early stages / while establishing the protective pattern. The actual lighting will be a matter of consultation between the F/C and the landholder with the F/C establishing the parameters under which any area shall be lit and the landholder having the necessary equipment to establish the fire danger index and to liaise on the day by radio with F/C. Forestry Commission participation is discussed again in the section on Departmental Participation.

An important part of the experimental approach in the Nunnion MGA will be monitoring the effect of the rational grazing programme on both pastoral values and natural values. This will require participation by the Soil Conservation Authority (to monitor the effect on pastures on soils), .. the National Parks Service to monitor the effects on the natural environment and presumably the Department of Agriculture(to monitor what is happening under the soil surface in respect of nutrient cycling and soil biology). The participation of these bodies is discussed separately.

TENURE CONSIDERATIONS.

A major problem in developing a rational grazing programme is the need for fencing with a tenure renewable annually, although there is provision for a seven year term under the Land Act. Licence holders will not be interested in fencing for better management unless they can have some guarantee of better tenure.

On the other hand, the AAPP recognises this and sets out (Page 119) that "subject to satisfactory performance, seven year grazing licences will be offered to graziers currently holding annual licences in the Alpine Planning Area" but no reference to those outside the planning area). However, it is considered that any offer of a 7 year term should be conditional upon fencing of the boundaries (where necessary) and internal fencing to encourage more efficient use of the grazing allottments by cattle.

The present approach to management in the alpine and sub-alpine areas is most primitive, forced on landholders by the annual term which completely discourages any attempt at improvements, these, whether structures or fencing, presumably becoming the property of the State with the licence holder having no rights in the event of his licence being transferred to another person. (The licence holders have had the experience in the past of having erected fencing or other improvements to improve use and management of an MGA and have had their MGA's thrown open for tender. Such a system merely needs someone other than the licence holder to recognise the value of the improvements and to tender accordingly.)

The other tenure stupidity is that which requires no boundary fencing except in a situation which requires a licence holder to erect fencing to prevent his cattle from wandering onto a neighbour's MGA, but imposes no obligation on the neighbour to share the cost of fencing to keep other cattle off his allotment.

It is considered that AAPP and the discussions which will flow in the preparation of the final document, provides a unique opportunity to regularise the tenure problems associated with mountain grazing allotments. Following is proposed:-

1. That licence holders be offered a seven year term subject to:_

(a) The erection of fencing on or near boundaries where there is no natural barrier to livestock movement, with the additional provisos:-

(i) that the location of such boundary fencing be determined by agreement by adjoining run holders with the final decision in the hands of the Minister in the event of non-agreement between parties.

(ii) That the cost of such boundary fencing including stock grids, be shared by the neighbouring lessees.

(iii) That licence holders be given tenant right in the value of improvements (as per Western Lands Actin NSW) and that this apply also to improvements such as watering points and to huts (so that licence holders may exercise some control over who uses huts).

(b) The erection of internal fencing to a minimum total length of 7 kms. (including boundary fencing) to facilitate livestock distribution and management - subject to the following additional conditions:-

(i) Any fencing in excess of the minimum total of 7 kms be allowed for as additional tenure at the rate of one years additional term for each kilometre of fencing in excess of 7 kms.

(ii) Licenced holders be required to instal stock grids where the public roads pass through any fence considered as a boundary fence and that each stock grid be cosidered as equivalent to one kilometre of fencing for the purpose of determing the current term of the lease. This condition to also apply to stock grids on internal fences.

(c) That additional grazing capacity be allowed for such fencing improvements commensurate with the areas commanded by internal fencing.

(d) That burning to reduce fire hazards be permitted in areas important to the protection of nearby forest resources and such burning be with the approval of and in association with the Forestry Commission.

(e) That huts located on MGA's be regarded as the property of the licence holder with tenant rights in their value and people wishing to use huts do so only with the permission of the licence holder.

(f) That the Lands Act be amended to provide for a lease in perpetuity upon completion of a 7 year term or other extended term as a consequence of fencing in addition to the maximum, subject to satisfactory performance.

(g) That the rental be determined at $\frac{1}{4}$ of the standard agistment rate for cattle averaged over the previous 5 years.

(h) That a maximum stocking rate for each MGA be determined in accordance with an appropriate? land classification scheme in relation to fencing location and that any increase in livestock carrying capacity sought by the licence holder be determined following an inspection by an officer of the CF & L Department*

The decision on stocking rates will take into account the condition of the country in relation to stock carried in previous years and the opening up of new grazing areas by fencing.

*Insert -- of grazing areas on the allotment during November, in company with the licence holder,

An outline of the talk by
Dick Condon to the AGM of the Mountain Cattlemen's Association of Victoria -- about 1986 or 1987, on "A new approach to management of mountain areas"

It is appropriate to mention that Jim C., then President of the MCAV, was familiar with the concept of rational grazing following contact with a Kelley Sullivan who had done the Savory HOLISTIC RESOURCE MANAGEMENT Course un USA. Jim C. was also aware that the writer had also done the course and had invited him to Araluen to exchange ideas on the concept.

Jim could see its possibilities for rational grazing in the mountain grazing country and was keen to expose the mountain cattlemen to the concept.

This outline was prepared in the form of an elongated news release.

A NEW APPROACH TO MANAGEMENT OF MOUNTAIN AREAS.

Mr. Dick Condon, former special soil conservationist with the N.S.W. Soil Conservation Service, a member of the former Kosciusko State Park Trust in the 1960's, and recently retired as Western Lands Commissioner in western N.S.W., spoke to the annual general meeting of the Mountain Cattlemens Association of Victoria on 19th. Sept. 1987, on land management in alpine and sub-alpine areas.

Mr. Condon's earlier experience in alpine and high mountain forest areas included direction of the Soil Conservation Service reclamation program in the Kosciusko Main Range area, the Kosciusko Road batter stabilistation program and co-chairmanship of the Snowy Mountains Soil Conservation Conference. This had the responsibility of ensuring the revegetation and stabilization of all exposed and disturbed areas resulting from the construction work of the Snowy Mountains Authority in building the Snowy Scheme.

Earlier in his career he had been in charge of research on the reclamation of scalded areas in western N.S.W., had undertaken and supervised soils, vegetation and erosion surveys throughout the same region, in central Australia and in the major catchment areas of N.S.W. From 1968 to 1984, he had been with the Western Lands Commission of N.S.W., responsible for the administration of the 32m ha of Crown lands which make up the arid and semi-arid grazing country of western N.S.W.

In the latter capacity, he had seen the devastating effects of allowing unreasonable fuel build-up in scrub and timber country when some 80% of the 2.2m ha of mallee country in western N.S.W. was included in the 3.7m ha burnt by the 1974-75 fires.

Mr. Condon considered this a most unnatural event because of the scale on which it occurred -- brought about by a policy of non-management in respect of nature's important management tool -- fire. The fire map of Australia for the 1974-75 season shows nearly half the inland of the continent burnt over by devastating fires. The Aborigines in central Australia insisted that that would not have happened under their management of the arid and sub-tropical landscapes, and were able to explain how they had used fire as a means of patch-burning on an individually small but totally large scale, this being able to prevent large scale and destuctive wild fires from developing.

The frequent small fires, ranging in age from one to ten years, had rejuvenated the areas so treated, providing the diversity of species and successional stages so necessary to ensure survival of the lesser species in the near-natural environment -- both of plant and animal life. Because of the likelihood of running into a recent patch burn within a few kms of their ignition points, wild fires, and their devastating effects under severe conditions, were also generally very limited in extent.

The Aborigines used fire similarly in the coastal, tableland and mountain landscapes, so that extensive wildfires, resulting from excessive build-up of fuel on the forest and woodland floor, were rare, and most wildfires occurred over relatively small areas. Before the Aborigines, lightning would have acted similarly to maintain the diversity of species and communities of plants and animals, but probably on a larger pattern than when under Aboriginal management.

Mr. Condon said that elements in the community keep pressing for more national parks and wilderness areas as a means of "preserving" examples of natural environment -- for the community's use and enjoyment, and for posterity. He pointed out , however, that we cannot"preserve" examples of natrutal environment as in a museum. Any attempt to protect natural areas from outside influences, and especially from /fire as nature's own principal influence, is imposing a form of management, or more correctly, non-management, the consequences of which can be worse than mismanagement. This applies in two principal respects -- in reducing the chances of survival of a great many species, and in encouraging conditions which will sooner or later, but inevitably, be the cause of extensive and severe wildfires which will destroy natural values over huge areas.

Mr. Condon pointed out that there is a well-tested relationship between the number of plant species in a community (and the number of animal species dependent on that community) and the length of time to a previous fire. The longer the time, the fewer the number of species in the community.

If the community wishes to have areas set aside as national parks and similar areas, it must also be prepared to recognise fire as nature's way of rejuvenating species which tend to be pushed out by more/vigorous or more space-occupying or more light-hogging species. It must insist that fire be used consciously and intelligently as a management tool with the aim of promoting species diversity and community diversity and natural values as close as possible to reality rather than/being muffled up by well-intentioned but misguided zealousness.

Although National Park authorities throughout Australia generally acknowledge the need for prescribed burning as a management tool, they are limited by lack of funds to do the job required -- and by pressure in the political arena by well-meaning people who forget the old adage that fire is a good servant but a bad master, and who see fire as intrinsically bad -- their attitudes being influenced by events such as Ash Wednesday, and the fact that the electronic media like to depict bushfires with flames bursting thru' the top of the TV set.

National park policies on the use of fire as a management tool also tend to be counter-productive in that prescribed burning tends to be used to establish a protective perimeter, allowing the build-up of fuel, and the unnatural values that go with it, for the inevitable holocaust on days such as Ash Wednesday, 1983 and Black Friday, 1939.

Mr. Condon said that the Alpine Area Planning Proposals also acknowledge the role of fire in the natural environment, but also seem to be overly concerned with "protection". This can only have unfortunate consequences in the broad range of landscapes under its jurisdiction.

He considered that authorities having large expanses of near-natural environment under their care should remove the word "protection" from their vocabulary and replace it with the word "management". This would lead to a positive attituude to management to replace the negatively defensive protective attitude that has prevailed for too long.

A protective attitude is all very well in a mild situation (which our Aboriginal predecessors would have been making good use of in a natural way) but was counter-productive to natural values in the long run and, inevitably, enormously destructive of the natural environment and of forest resources, and of life and property.

Mr. Condon also spoke on holistic resource management -- a new approach (for Australia) to management of the natural, physical and biological resources, whether they be national parks, wilderness areas, commercial forests or farming and grazing properties. This approa ch has been used in some other countries for regenerating degraded environments and improving productivity , by promoting positive management towards well-considered objectives.

Holistic (as in whole rather than holy) resource management uses a management-oriented model which recognises the basic eco-system "engine-blocks" of plant succession, water cycle, mineral cycle and energy cycle. It then lists the tools which can be used on the eco-system blocks to steer the eco-system (again whether it be plant/animal communities in the wild, or a farming or grazing property, or a paddock on such a property) towards /the objective, but recognising the interdependences within the eco-system.

The basic tools are fairly ordinary, embracing concepts such as grazing (light, heavy, moderate, short duration etc.) rest, fire in its many nuances, animal impact (dunging, urination, hoof effects etc.) and technology as means of manipulating living organisms, and as acted upon by such things as money, labour and human creativity.

As an aide to problem-solving, the management model includes a set of guide-lines which embody the whole eco-system (at the top of the list), social and cultural aspects (in respect of the human resources in the eco-system), weak links (to repair and strengthen the chain), causes and effects, time and growth rate effects, interdependent reactions, flexibility and many others. Finally, and over-riding all others, is the admonition or constant reminder to "plan - monitor - control - replan".

The basic tool in the application of HRM to a grazing prop erty is the concept of rational grazing, familiar and second nature to shepherds, peasants/and herding animals for millenia, based on short duration heavy grazing alternating with long -term rest. Continuous light grazing, even for only 4-6 months at a time tends to be debilitating in terms of pasture composition and plant vigour, depleting the more palatable species and, thereby, oviding space for the less palatable and weed species.

Rational grazing immediately puts a strong manipulative tool in the hands of the pasture manager -- enabling use of a a pasture at its most productive and nutritious sta enabling uniform use of the whole pasture rather than selective grazing, allowing the grazed plants to recover using the combination of solar energy and chlorophylll rather than calling on its root reserves -- and enabling effective use of a wide range of plants which are moderately palatable in the early and middle growth stages, but which become unpalatable and even weed species in the late stage of growth under continuous light grazing.

The "despised" cloven hoof, in greater numbers uniformly over the pasture, becomes a soil renovator, jazzing up the water cycle and improving the mineral cycle by hastening the incorporation of plant matter into the soil rather than letting it hang around in the air for years before being returned to the soil.

The pay-off is in improved productivity resulting from more effective and efficient use of the pastoral resource, and improved soil condition as a consequence ofbetter water cycle and improved mineral cycle. A side benefit is often reduced need for fertilizers and for chemicals for weed control and other purposes.

We have been giving lip-service for so many years to the need to "protect" degraded areas and regenerate them by de-stocking or eliminating stock altogether, that it becomes difficult to accept that we can speed up the regenerative process by increasing stock numbers -- but that is what happens in practice.

The holistic management approach can be used in the management of national parks and other near natural areas including areas used for mountain grazing -- to the benefit of natural values and production values. Now that recent research has found that cattle are not the despoilers of our high country as we have been led to believe, we can perhaps think more positively about how we can use them to promote the well-being of natural and near-natural environments.

WE can now find it easier to accept that if cattle have occasionally caused damage to our highland grazing country, we can lay the blame, not on the cattle but on the primitive form of management forced on thecattlemenn by the current tenure conditions.

If we are concerned about the cost of using fire as a management tool on the the scale necessary to promote natural values and to <u>really</u> protect our forest resources from extreme wildfire, perhaps we ca think positively about using cattle to reduce the need for fire as a management tool, to open up the areas of senescent snow grass which is currently constituting a severe fire risk to forest and bog environments -- to provide space for herbaceous plants plants which are crowded and shaded out by the dense mat of senile snowgrass foliage which will otherwise take years to get back to its rightful place in the soil.

But there is no way in which we can expect the mountain cattlemaen to use positive management to promote natural values and to provide more effective protection to the forest resource unless the present serious disincentives to intelligent management are removed by bringing the tenure system up to date with modern practice.

MR. Condon explained how he had been conditioned in earlier years by the attitude, supposedly backed by research, that we needed to protect our natural environments from catastrophes such as mild fire and grazing. However, his observations over nearly 40 years, in a wide range of difficult environments, had led him to the conclusion that we needed to protect our environments whether natural, forest or pastoral, from the <u>excesses</u> of fire and grazing, but to be prepared to use these use these intelligently, along with other tools, to prevent those excesses.

He considered that the greater the area of landscape being brought under central management, the greater the need for a holistic approach to that management. This will involve the setting of clear but realistic objectives, both for the whole area, and for individual units of landscape within the whole -- and a positive approach to management rather than a defensive negative approach which currently stifles our attempts to manage our natural resources intelligently.

Extracts from

A SUBMISSION TO THE

MINISTERIAL TASK FORCE INVESTIGATING FUTURE OPTIONS FOR CATTLE GRAZING IN THE ALPINE NATIONAL PARK

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The following material has been taken from the above submission. It is primarily about what has happened to the environment in the Kosciuzko National Park embracing the high mountain country in New South Wales and the implications for the Alpine National park in Victoria It discusses the supposedly adverse impacts of cattle grazing, pointing out the severe, but somewhat limited erosional effects of the extreme grazing which occurred in earlier times in areas of the Main Range generally over 6,000 feet where frost-heave effects in autumn and spring cause active and continuing erosion on any area of bare soil on a more than gentle slope.

It discusses the supposed effects of cattle grazing on conservation values and described the favourable environmental outcomes from over 130 years of summer grazing in the freehold grazing country adjoining the Kosciuzko National Park on its eastern side. These areas have effectively healed the scars of the severe erosion in that country which resulted from that ameuncontrolled heavy grazing which had such adverse impacts in earlier times.

CONTENTS

A. THE ADVERSE EFFECTS

1. Erosion

The Main (Kosciuszko) Range in NSW

There is extensive sheet erosion of slopes around the summits of Carruthers Peak and Mt Twynam in areas generally above 6500 ft (2,070 m) At this level, conditions in respect of frost-heave, which creates continuing erosion on bare soils when not covered by snow, and wind, are extreme. Bryant (1971) carried out a detailed survey of geology, soils, vegetation and erosion, based on aerial photos and detailed ground inspections, of the Upper Snowy Catchment above Guthega Dam. This survey recorded 59.7 % of the 8,115 ha catchment area as nil erosion, with a further 28.7 % as slight erosion, with up to 25 % of areas so affected as bare and eroding as sheet erosion. Only 3.4 % of the area was recorded as suffering from moderate sheet erosion and 0.9 % with gullying, the areas affected in these ways amounting to a total of 400 ha

By comparison, the area occupied by snow patches (in which snowdrifts persisted for most of the spring-summer-autumn) amounted to 2.85 %(265 ha), this representing more than half the area affected by severe sheet erosion and gullying. Bryant reported that gullying appeared to be confined to three situations :--

-- tracks (bridle and walking),
-- in and around damaged snowpatch areas,
-- a former stock camping reserve,

while incipient gullying is present in severely sheet eroded areas.

Much of the more severe erosion can be attributed to the presence of a Travelling Stock and Camping Reserve near the summit of Mt. Twynam, marking the junction of two Travelling Stock Routes. It is well known that the high mountain country in both NSW and Victoria provided relief grazing for millions of sheep and cattle from the Riverina and northern Victoria in the 1888 drought, and especially the 1895-1903 drought, and several other droughts through the first half of the 20th century.

In these circumstances, it needs to be asked -- do we blame the grazing animals, or the two-legged animals responsible for permitting such heavy grazing, and for a stock route along the ridge of the main range north-easterly of Mt Kosciusko, and a camping reserve on one of the highest peaks at around 7,000 feet (2130 m) in an area subject to such climatic extremes. It must also be asked how the erosion damage described above will compare with that which will occur as a result of the baring of the soil over huge areas of montane forest and subalpine

grassland and woodland by the catastrophic fires over the summer of 2002-03 -- a situation for which two-legged animals are also largely responsible.

In sub-apine areas in adjoining freehold grazing areas

It will be appreciated that whether cattle create an erosion problem will depend on numbers per unit area (and especially time spent at high numbers per unit areas) and the related grazing and trampling effects, and the severity of the erosive agents.
The sub-alpine country forming the catchment of the Gungarlin River on the eastern boundary of the Kosciusko National Park, and at elevations ranging from 5,000 feet (1,520m) to 6,000 feet (1826m) had been grazed each summer for over 130 years when inspected in much detail in the 1980s. This country would also have been subjected to the drought-induced heavy grazing of earlier times. Observations in this area at that time showed plenty of evidence of past erosion in gullied streamlets, but these are now stabilised with herb, snowgrass and bog species on the sloping shoulders with the brooklets running clear. It was obvious that former severe erosion in this area has been able to stabilise itself in a regime of sensible cattle (and sometimes sheep) grazing.

The only active erosion observed over several days in three inspections of this country was that due to wombat holes on short steep convex slopes leading down to small streamlets. In these areas the wombats keep areas in excess of 1,000 square metres bare by their constant activity on the bare and eroding surfaces.

Application to Victoria's sub-alpine grazing country

Experience in the Kosciuszko region has shown that cattle, in sensible numbers, can graze sub-alpine grassland and woodland without creating even minor erosion problems, and been able to stabilise the erosion from earlier, less circumspect, times. As will be shown in a later section, cattle grazing can also be used to improve conservation values by encouraging alpine flowers and discouraging shrub invasion of grassland areas.

In the Victorian high country, cattle numbers on the Bogong High Plains have been reduced over time from 18,000 in the period pre-World War II, to 10,000 in the post-war period, and from about 1977, to 4,000, the latter a voluntary reduction by the cattlemen in their concern that perhaps the researchers were right after all, and that cattle grazing was having adverse effects on conservation values. The continuing expansion of areas infested by heath, in areas from which cattle have been withdrawn and on areas now lightly used on the Bogong High Plains, suggests that present cattle numbers are too low, and need to be increased to prevent more areas of alpine grassland from being invaded by shrubs. This has happened over substantial areas of former grassland in the Kosciusko National Park, effectively destroying the amenity of such country for passive recreation.

2. Conservation Values

In the expectation that the Victorian National Parks Association will be making a submission to the Task Force, this submission takes the opportunity to put forward some contrary views. In the past, the case for the Victorian National Parks Association has been set out in a paper by Barnett (1987) on *The Effects of Alpine Grazing on Conservation Values -- the research behind the debate*, this paper being published under the auspices of the Victorian National Parks Association.

It is proposed to consider each of these items (and some others) in turn to see what traditional cattlemens' wisdom, the research to that time, and the presence and absence of grazing have shown.

(a) *Damage to sphagnum bogs*

Early researchers in the high country were quick to blame cattle as responsible for breaking up the sphagnum mossbeds so that the small streamlets, which previously went over and filtered through them, broke through, serving to drain them and lower the water table so that the sphagnum and other bog species were gradually replaced by matted snowgrass. It was also claimed that this drainage also had adverse effects on the water-holding capacity of the bogs and, hence, on catchment efficiency in respect of hydro-electric water storages.

The cattlemen were puzzled by this, having known that cattle tend to avoid bog areas (other than to drink from the edges) always picking the narrowest point to cross a stream rather than struggling through a bog area. Research by van Rees and Hutson (1983) and van Rees (1984) found that cattle spent only 5 % of their time in bog sites, these occupying 10 % of the sub-alpine landscape.. This included grazing on their way through a bog area, but only a small proportion entered a moss-bed to graze rather than to drink.

This level of use would not seem to be sufficient to break up the moss-beds. However, the greatest damage to moss-beds occurs with wildfires at times when the moss-beds are drying out because of a run of relatively dry seasons. It has been reported that moss-beds in the Kosciusko area smouldered for weeks after being set alight by the 1939 bushfires in a very hot and dry summer. Having seen bogs after the very hot March 1965 fire in the great divide area above Ravine and Lobs Hole looking like blackened rabbit warrens after obviously smouldering for several days, until the next rain in early April, it is not difficult to understand how the run-off from heavy rains after that fire could break through a weakened hillside bog structure to form a draining streamlet through the bog.

Likewise, it is not difficult to understand how a stronger streamlet could cut through the broad expanse of a valley bog after such damage following a wildfire in a dry summer. The 1939 fires would have had such an effect. The widespread fires of the 2002-03 summer would also have had a major effect on the condition of hillside and valley bogs in such a hot dry summer.

(b) *Creation of bare ground and damage to soils.*

The damage that might be caused by cattle in this respect has a somewhat hollow ring after the tens (hundreds ?) of thousands of hectares of bare ground, especially on steep and precipitous slopes in montane forest areas, created by the widespread fires of the summer of 2002-03, in both the NSW and Victorian high country. In 10-20 years time it will be interesting to see whether the erosion damage from earlier cattle and sheep grazing in the KNP amounting to perhaps 1,000 ha all told, pales into insignificance compared with that caused inevitably by the failure to use fire, in combination with grazing, as a management tool for natural areas.

It has been claimed that cattle grazing leads to bare ground. In areas where grazing pressure is high, it can be expected that that there may be more space between snowgrass and other plants than in the absence of grazing. In any mountain grazing area, without the control that can be exercised by fencing in lowland pastures, grazing rates will vary from several beasts per ha in the vicinity of salt licks which are used to facilitate distribution in a grazing allotment, to one beast to several hectares in areas well removed from the current salt lick site.

If a salt lick remain at the same sites for several weeks, there will certainly be overgrazing at such sites. However, if the salt-lick sites are moved around at relatively short intervals, the short period of heavy grazing and mild trampling will normally do much good in terms of increasing penetration of rainfall moisture and re-cycling of nutrients to the area.

The need is to move the salt blocks to another site before adverse effects begin to show, preferably to an area as far as possible from the immediately previous site to ensure that the latter gets a useful rest, and having in mind that the next move should not be too close to the former site. The real need in respect of research into the effects of grazing is to undertake research into grazing management to determine approaches that will ensure maintenance and even promotion of conservation values.

(c) *Serious erosion in some areas.*

The cause of the serious erosion around the high peaks of the Kosciusko main range have been discussed previously. Within the Kosciusko National Park there are other sites where there has been serious erosion. In the vicinity of Bulls Peaks and the Brassy Mountains about 30 km further north-east along the main dividing range, these around 6,000 ft (1826 m), more in places, where strong winds falling over a steep and high scarp on the immediate east would develop very high velocities over the ridge of the great divide.

The only other area of severe erosion seen by the writer in six years or so of walking, driving , riding and flying over the Snowy Mountains region at intervals of two to four months was on the approaches to the eastern end of the Tantangara Dam wall. Here, there has apparently been a concentration of travelling stock in earlier times moving in to and out of the snow lease grazing areas. When observed in the late 1980s this was undergoing a mild recovery with snowgrass, herbs and low shrubs, establishing on the loose frost-heave soil accumulating at and working up from the bottoms of the 40-metre-long, steep slopes.

Erosion in the form of scalds to 20-30 cms depth, varying in area from 1,000 to 5,000 square metres were scattered through the sub-alpine grassland at a frequency of about one such site per 100 sq. kilometres. Again, the question arises as to the severity of such erosion, most likely created also as a consequence of the earlier extreme stocking levels in drought times, and the 1939 fires, compares with that which will have been created by the severe wildfires in the summer of 2002-03.

The writer has spent several days in various parts of the Victorian high country, including two days of detailed field inspection in the Bogong High Plains. Nowhere did he see erosion exceeding an area of 100 sq. metres. The one exception was where a snow drift lay across an electricity authority open aqueduct, this serving to cause the water that should have flowed along the aqueduct during snowmelt and after heavy rains to be to be diverted over its lower bank, causing gullying over a wide but small area downslope, and risking the breaching of the bank and subsequent severe gullying. This is apparently a common occurrence.

At another site, bushwalkers approaching a nearby hut, and concentrating on only one of a pair of shallow but bare vehicle tracks, had caused a shallow rill which, in time, would become a serious gully unless steps were taken to divert the small flow back onto stable grass cover at frequent intervals.

(d) *Changes in vegetation structure.*

This refers to changes over much of the high country, in both NSW and Victoria, in which snowgrass grassland is being invaded, on a large scale, by native shrubs, forming a dense heath over increasing proportions of the grasslands. It also refers to the removal of alpine flowers which is supposed to happen under grazing.

In respect of shrub invasion, researchers and others in Victoria point to where this has happened in grazed areas. This has certainly happened on the Bogong High Plains since cattle numbers were drastically reduced in the late 1970s. Is this because of the continued grazing, or because the numbers of cattle using the area have been drastically reduced, so that current grazing pressures are not sufficient to prevent the heath from taking over grassland.

In the Kosciusko National Park, in areas which have been free of grazing since 1958, extensive areas of grasslands in the Jagungal area and in the area generally north-easterly of Kiandra comprising what is known locally as Long Plain, are being invaded by heath, areas affected ranging from 50-60% of the total landscape in the former area and 30-40% in the latter. These estimates were made by the writer in the late 1980s. It can be expected that these proportions will have increased substantially since.

In these areas, and especially in the Jagungal area, the effect has been to adversely affect the amenity of the area for bushwalking and fishing, access for walking through these areas being now largely confined to the former vehicle tracks. This country had once been highly regarded for bushwalking, giving expansive views of rolling downs and rugged mountains, and providing easy access to the plentiful streams for trout-fishing. Walkers have abandoned the Jagungal area for the adjoining freehold sub-alpine summer grazing country where it is possible to find an

easy place to pitch a tent beside a stream and have a safe campfire -- and enjoy alpine wildflowers in profusion (see below).

The Jagungal area was once popular for cross-country skiing, but in the heavy heath cover this becomes largely impossible. In the Victorian ski fields it has become necessary to slash the invading heath in order to provide good skiing.

The situation after continued summer grazing after 130 years on freehold grazing country

For those researchers and authorities who insist that fire creates bare space which becomes occupied by shrubs, the freehold sub-alpine summer grazing country adjoining the eastern side of the Kosciusko National Park has some lessons. The occupiers here have been able to use mild fire in the late autumn to clean up the heather moving down out of the snowgum woodland on the higher knolls. The bare spaces so created are quickly reoccupied by snowgrass along with plentiful wildflowers. in the following spring. This is happening in areas being grazed by cattle every summer. The graziers keep the fire out of areas where there is an understorey of heavy shrub growth, knowing that the hot fire in such an environment will kill the mature snow gum trees and encourage a dense forest of snowgum saplings which, in turn, are easily killed by fire as fuel builds up on the floor. The dense sapling forest creates an environment unsuitable for animals other than some birds and invertebrates.

In the same area, comprising the catchment of the Gungarlin River before it joins the Snowy River above Jindabyne Dam, the summer graziers have been able to encourage wildflowers at crop density by the simple expedient of deferring their grazing to begin in January rather than November of each summer. Although a proportion of the wildflowers will be consumed, enough will be left to provide a good seeding every year, with some of the seed being passed through the animals' digestive systems, perhaps to promote germination. It is easy to encourage such an approach to grazing where there are fences to control stocking -- and easy for the holder to arrange late grazings alternately each year to keep the wildflowers coming. A little bit of serious thinking may be able to devise a similar approach for the Victoria sub-alpine grazing (and non-grazing} country to improve the floral displays.

Just how adverse (?) cattle can be in grazing out the wildflowers can be judged from the following story. In the early 1980s the KNP administration was taking action to resume some of the freehold grazing country around a paddock surrounding Davies Hut because of the wonderful display of wildflowers thereon. The holder managed to get them to agree to an exchange for a similar area of land from the Park, but adjoining his country -- which the Park was happy to agree to because of the total absence of wildflowers. Within a few years, the wildflower display in the Davies Hut paddock was weakening in the absence of the grazing cattle, while the flowers in the area taken out of the Park was then lush with wildflowers. The secret in encouraging wildflowers was in deferring grazing to January each summer. In the Davies Hut paddock, with the lack of grazing, the snowgrass was crowding the flowers out.

There are several things wrong with this scenario of supposedly near-pristine wilderness in the Kosciusko National Park :--

(i) The dense mostly dead snowgrass provides an easy target for lightning strike ignitions

-- as does the enormous build-up of fuel in forested areas as a consequence of total lack of prescribed fire (and prescribed grazing) for the last 40 years or so.

(ii) In the absence of mild fire or grazing there is very limited recycling of nutrients.

(iii) the dense dead snowgrass becomes an ecological desert in terms of plant life and animal life with minimum biodiversity -- except for ants. The habitat of kangaroos and wombats is confined to the limited "oases" of fertility of a hectare or so surrounding the former homesteads and stockmen's huts which the native animals are able to keep permanently green. There is nothing for them in the dense snowgrass or heath beyond these areas.

(iv) In the areas being invaded by heath, the snowgrass and the herbaceous plants are also being pushed out by competition for moisture, light and nutrients -- again a serious loss of biodiversity in which the lesser plant species (more likely to be rare or endangered) are likely to disappear.

The need to re-think attitudes to alpine grazing

The above review of the effects of cattle grazing in promoting conservation values suggests the need for a serious re-think on the place of cattle in the Alpine National Park. That re-think should extend to approaches to the management of cattle grazing to encourage its use as a management tool, especially in areas from which grazing has been withdrawn.-- how they can be used to promote biodiversity, how they can be used to encourage alpine flowers, how they can be used, perhaps with careful use of fire, to reclaim areas of former grassland presently being taken over by heath. The continuing spread of heath in the Bogong High Plains is indicative that the cattle numbers are too low.

The re-think would best start on areas of sub-alpine grassland and heath that may have been severely damaged in the widespread and catastrophic fires in the summer of 2002-03 and be at risk of serious erosion -- with a view to managing their recovery. This should extend to thoughts about the use of cattle in areas from which they have been excluded for many years, especially as a means of encouraging recovery of areas so severely damaged that they become an erosion risk. While their is still soil on such areas, and before they regress to an erosion pavement dominated by stones, the simplest way of regenerating plant life is to drive a herd of cattle over and through such areas when the soil is suitably wet after rain -- followed by seeding with snowgrass and other suitable native species. Clover species and superphosphate and perhaps other fertilisers can be used to build up fertility and maintain fertility at a high level until the native species are well established. The Kosciusko experience has shown that withdrawal of fertilisers will see the introduced species disappear.

Several introduced species of grasses and clovers were used in the summit area reclamation program on the Kosciusko Main Range in the 1960s. On a visit to the works in the Mt Twynam area in the late 1980s, it was noted that natural areas under snowgrass or daisies surrounding the reclaimed areas were free of any of the species introduced in the reclamation program.
In areas subject to frost-heave it would be desirable to provide a mulch. In areas where vehicle access is possible, hydro-mulching as used on the Kosciusko Road (see Clothier and Condon,

1968b). could be used. Another possibility would be the use of snowgrass turf, taken in narrow strips from well-grassed areas and laid in strips on the contour across areas needing treatment. Turf-cutting machines the size of a household lawnmower were available in the 1960s.

The other matter which needs serious consideration by national park managers is using cattle grazing as a means of improving habitat for native animals, not only in the Alpine National Park but in national parks in other environments. Svenson (1990) records the proceeds of a conference of wildlife managers, presenting papers describing their use of prescribed grazing of livestock for this purpose in a wide range of environments in North American national parks.

B. Beneficial Effects of Cattle Grazing

Most of the beneficial effects of cattle grazing, and the reasons for them, have been discussed in the preceding section dealing with the supposedly adverse impacts. It remains to summarise those previously discussed and to discuss other beneficial effects in greater detail.

1. *Improvement in habitat for native wildlife.*

Cattle grazing serves to keep the snowgrass sward in a fresh and green condition throughout the summer in sub-alpine grasslands and woodlands. Ideally it also needs the use of mild fire in limited areas to prevent the snowgrass from senescing and crowding out other plants.

2. *Improvement in alpine flower production.*

The preceding section has shown also that although cattle preferentially graze wildflowers and other herbaceous species, grazing can be timed each year to maximise the plant (and consequently faunal) biodiversity.

3. *Reclamation of eroded sites*

The availability of cattle in the local environment can enable them to be used to treat eroded areas. Mention was made of the use of cattle by droving them over and through sheet eroded areas when the soil is wet following good rains -- to provide niches to hold seed (and fertiliser) and rainfall moisture in place to encourage germination and establishment, preferably using native species, but understanding that if introduced species are used, they are most unlikely to invade natural areas nearby.

In the grazed sub-alpine grasslands adjoining Kosciusko National Park the most effective coloniser is the weed species known as sheep sorrel (*Rumex acetosella).* It is an aggressive coloniser on bare and disturbed sites, largely absent from nearby natural areas and disappearing as the snowgrass and daisies become established. In the Kosciusko National Park this species was also once common on construction sites undergoing reclamation

undisturbed

4. *Control of shrub invasion*

Although cattle do not favour some tall heath species in their mature condition, they will use these and other shrub species in the seedling and young bush stages. The shrubs invade grassland by spreading out from established mature stands, occurring initially as scattered

individuals amongst the snowgrass, such sites increasing in density and height of shrubs until they become impossible to walk through. In the process they push out the snowgrass and herb species. In this condition the shrubs leave a mulch of organic matter on the soil surface which, in the event of a hot fire, is completely consumed, leaving the mineral soil bare and unprotected and susceptible to frost-heave in the non-winter season when not covered by snow,

When young shrubs are in a scattered distribution, cattle are able to keep on top of the problem. In the freehold summer grazing country adjoining the Kosciusko National Park, graziers have been able to use mild fire in the late autumn to remove mature tall shrubs which cattle have not been able to suppress, with snowgrass and herbs returning to provide adequate cover in the spring.

There is a place for these approaches in areas in the Alpine National Park from which cattle have been withdrawn. There could also be a place for using cattle grazing and mild fire on the ski slopes where shrubs are needing to be slashed to groom the slopes for skiing.

What these approaches need is someone to think seriously about what has previously been considered unthinkable by the authorities striving to appease the minority of the community in the conservation movement

5. *Protection against wildfires at unseasonable times*

Overgrown senescent snowgrass makes for easy ignitions by lightning strikes in hot and dry summer conditions, as does heavy loads of leaf and bark litter on the forest floor. It is interesting to note that, prior to the January 2003 fires in the Canberra area, bushfire brigade personnel in the area west of the ACT had measured forest floor fuel loads ranging between 84 and 200 tonnes per ha.

The most effective way to remove overgrown senescent snowgrass is to use mild burns in patches in the late autumn, when any fire will be extinguished by the coldness and moistness of the night air and the subsequent morning frosts. This would be resuming the practices of the Aborigines when they visited the high country for feasting on the bogong moths and other local foods.

Burning the patches of senescent snowgrass in this way will result in patches of fresh green growth in the snowgrass sward in the following spring -- to attract native wildlife and to provide space for plant species other than snowgrass to become established -- thus promoting biodiversity. Patch burning in this way is how the Aborigines managed the multitude of environments throughout Australia, and kept them productive in terms of their food supply. By this means also. they were able to minimise the areas which might be affected by the occasional catastrophic wild fires

It is also appropriate to discuss the experience of bushfire brigades in fighting the 2002-03 fires in sub-alpine grassland areas of the Kosciusko National Park. Although it is generally easier to control fires in grass country than in forested and timbered land, the task in the Long Plain area of the Park was made much easier because the fairly large brumby population in that area had been able to keep the much of the snowgrass grassland in a green condition, this serving to slow the fires down to enable fire fighters to bring them under control more easily. As a

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There is also a place for cattle grazing in forest areas as a means of providing some protection from wildfires. Cattle are able to use valley areas and gentle slopes -- to keep the grasses on the forest floor invigorated, to utilise the shrubby understorey to reduce the volume of such fire hazard, and to maintain habitat for native wildlife.

The nature of ecological research

Environmental research is always difficult in that, no matter how good the intentions and thorough the design and execution, it can never hope to cope with the multitude of influences that can impact on the environment. This creates problems when it comes to analysing the results -- because the researcher can only discuss the results in relation to the treatments imposed. He will have difficulty (not necessarily acknowledged) in trying to separate out the effects of those influences which he hasn't had under control, and which may not have happened during the currency of his research.

The attempts of some researchers to prove the supposedly adverse effects of cattle grazing have been outstanding in the amateurish design and childish attempts to simulate the effects of cattle grazing. One piece of research (quoted by Barnett *op. cit.*) used a range of treatments on one-metre-square plots to study the effects of bare space in the snowgrass in promoting shrub establishment. In some plots, snowgrass plants were pulled out of the ground to simulate the effect of cattle grazing in creating bare space.. The effect, of course, would be to provide enough disturbance, and space, and reduced competition from the remaining snowgrass stand, to encourage the bountiful seed store in the surface few centimetres of soil to germinate -- with species suited to the timing of the following rainfall. In a heath/grassland community, it can be expected that some of the seed store would be of heath species. If cattle grazing is having such adverse effects, it is amazing that the researchers could not find examples of such damage in grazed landscapes without having to simulate it in a stand of good snowgrass.

The same researchers attempted to simulate the damage caused by the swift moth in killing snowgrass -- by clipping the snowgrass at ground level over the one-metre-square plot and holding the clipped material down with plastic mesh to prevent the wind from blowing it away.

Not surprisingly there was a good response from the culms of the clipped snowgrass, sprouting through the clippings. Perhaps they didn't know that when swift moth, or case moth, kills snowgrass it kills everything, roots and all.

In large areas, up to 20 metres in diameter or more, re-colonisation of moth-killed areas is very slow, as in years, with very scattered herbs, and occasional shrub and an occasional snowgrass plant. The writer would expect that a bit of disturbance by cattle hooves to break up the tightly packed snowgrass hay would provide spots for seed to lodge and germinate and, in doing so, to serve a useful purpose in reclamation, even if it is by shrubs.

There is also the question of truth in research, this aspect being explored in a series of papers to the Australian and New Zealand Association for the Advancement of Science (ANZAAS) held in Townsville in August, 1987 and in following issues of the Association's journal *Search* , these providing some uncomplimentary views about scientists. Caton in the September-October 1987 issue of *Search*, amongst several less than complimentary quotations from eminent scientists, quotes astronomer Sir Federick Hoyle's statement that " Pressures are so great towards orthodoxy that it unwise for a young scientist to report an observation or an experiment should it happen to favour a declared heresy." Caton further reports that the growth of the sciences since 1945 has been accompanied by an enormous increase in the institutional power exercised. The writer is well aware of the influence of institutional power in alpine ecological research.

The effects of withdrawing cattle from an alpine national park

The supposedly adverse impacts of cattle grazing which appear to have been shown up by much of the ecological research, has not been matched by reality. The beneficial impacts of sensible cattle grazing have been shown by the reality of continued alpine summer grazing for over 150 years in sub-alpine areas adjoining the Kosciusko National Park in New South Wales. Those areas do show some scars of the 80 years or so of intense grazing pressures in earlier times, but that evidence of former erosion is now almost completely healed.

The principal concern for for withdrawing cattle grazing isfor the seriously adverse impacts which inevitably result from lack of cattle grazing in much of the Park, combined with a lack of prescribed fire. The inevitable result of this policy of non-management of the Kosciuszko national Park, and particularly the montane forest, has been the catastrophic fires through the high country in Victoria and New South Wales in the summer of 2002-03. It would be a safe bet that erosion and ecological damage caused by cattle grazing would pale into insignificance compared with the erosion and ecological dislocation caused by those fires. The 2002-03 fires are a monument to mis-management.

In the Kosciusko National Park 3.1 million ha have been burnt with huge areas of mountain ash (highly susceptible to hot fires) killed outright. There will be no recovery of these by epicormic branching as occurs with most eucalypt species damaged by fire. It is presumed that this has happened in the Victorian high country also. The grey patina from the dense stands of dead trees will serve as a reminder of those fires for the next fifty years until the next inevitable

catastrophic fire occurs on a similar scale -- unless the current approach to the management of natural areas is changed.

The need is for positive management to avoid a repeat in the future -- by intelligent use of prescribed grazing and prescribed fire – not only for fire prevention and easier control, but for improved environmental outcomes..

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