A prescription for Kosciusko

No livestock, no control burning, and no rabbits. That's the prescription (more a proscription) for preserving our sub-alpine environment, according to the results of an 8-year study by CSIRO researchers in the Kosciusko National Park.

Livestock were excluded from the Park area nearly 30 years ago, but the other two factors continue to influence plant life below the tree-line. Close study of 0·5-ha experimental plots on the Kiandra Plain has now shown that fire and rabbits greatly increase the amount of erosion-susceptible bare ground, and that rabbits can have a devastating impact on alpine flower species.

Rabbits are not particularly prevalent in the sub-alpine woodlands of the high country (they are at the upper end of their altitude range) and have not previously been seen as a significant problem for the integrity of the Kosciusko Park. They mostly keep to country between the winter snowline (about 1400 m) and the tree line (1850 m) — the sub-alpine areas that occupy about one-third of the Park's 7116 sq. km. To the casual observer, their presence is only apparent from a 'lawn' surrounding burrows and a lack of young saplings nearby.

The experiments involved average rabbit densities of only about seven or eight per ha — roughly half the maximum observed in the immediate area. However, the substantial impact they wrought can be explained by the very high discrimination of their palate.

Just like the livestock before them, they avoid the tough snow-grass tussocks (which account for about one-third of the vegetation cover) and concentrate their attentions on the tender-leaved forbs. These 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. Alpine celery, silvery carraway, golden moths, and native leek are all favourites on the rabbits' menu.

Rabbits had a drastic effect, eliminating nine plant species.

'If we want to return Kosciusko to the full glory of its wilderness state, then we'll have to get rid of the rabbits', says chief investigator Dr John Leigh.

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. In the interests of nature conservation and water-catchment protection, livestock were banned from the New South Wales high country in 1958 — when up to 40% of the sub-alpine grassland had become bare soil.

Ecologists from the CSIRO Division of Plant Industry, principally Dr Alec Costin and Mr Dane Wimbush, subsequently documented the rapid and marked healing effect on the countryside that this measure brought about (see *Ecos* 22).

Effects of fire, rabbits

The latest work, undertaken between 1976 and 1984, was a continuation of the earlier studies. This time Dr John Leigh and Mr Wimbush, from the same Division, were the principal investigators, and they were aided by Dr Don Wood of the Division of Wildlife and Rangelands Research. Their primary object was to investigate the impact on the plant community of two factors: fire (as in controlled burning), and grazing by native and feral mammals (the majority, as it turned out, being rabbits).

In 1976 the researchers selected a typical 12-ha portion of sub-alpine land in the valley of the upper Eucumbene River, near Kiandra. They subdivided the area into half-hectare plots so that snow-gum woodland occupied about one-third of each and open snow grass country (because of a frost hollow) the rest. After burning half the 24 plots in autumn 1978, they applied four different grazing treatments to each half:

- ungrazed (fenced to keep all grazing animals out)
- moderately stocked with a known number of rabbits — about four per plot (more in spring, less in winter); within the fenced enclosure rabbit numbers were adjusted to compensate for escapes, deaths, or breeding

A mobile steel frame and patience — compiling a plant inventory.

The quiet marauders. When released onto the fenced plot, these few rabbits made a meal of the palatable plants.

- ▷ grazed by feral rabbits only (a wide-mesh fence kept out wombats, wallabies, and kangaroos)
- ▷ open to all and sundry (unfenced)

When the results were in, the figures for the last two treatments were nearly identical, indicating that the vegetation can easily accommodate native mammals' appetites. Feral rabbits exert nearly all the grazing pressure on sub-alpine plant communities.

The 12 unburnt plots were protected from fire; the others were burnt twice at low intensity, once in autumn 1978, and again in autumn 1982. (The last wildfire, which burnt the entire area, occurred in January 1965.)

Monitoring of the plots was very thorough. Every 5 weeks, when the area was free of snow, the scientists caught (not without difficulty) and then counted the rabbits in the stocked plots. They also counted the number of faecal pellets found on 120 areas, each 1 m × 1 m, which were evenly spaced throughout the study site.

This gave a good indication of rabbit numbers, and where their feeding was concentrated (during a single night, a foraging rabbit disburses about 300 pellets). Over 5 weeks, the number of pellets recovered and recorded by the researchers ranged from an average of 3 per sq. m for unburnt grassland (in 1983) to an average 408 per sq. m for burnt woodland (in 1980).

Although the researchers sampled the vegetation only once a year — at the height of the growing season in January — their analysis of the samples took them the rest of the year, and sometimes extended into the next. Every summer they harvested 36 sq. m of plant material (living and dead), dried it, and weighed it to give measurements of biomass over all the plots. For four of the eight years each branch, leaf, and blade of grass was sorted into its characteristic species — a very demanding task!

The great value of the exercise was that it allowed the scientists to assess changes in species abundance, and provided them with figures on plant productivity and fuel levels.

To gain a wider view, they allocated the species data among eight categories: tall shrubs, low shrubs, snow grass, other grasses, palatable forbs, unpalatable forbs, sedges and rushes, and mosses and lichens.

Other data gathered at midsummer included estimates of percentage ground cover derived from 800–900 observations on each plot. Detailed measurements of how various layers of cover overlapped were also made.

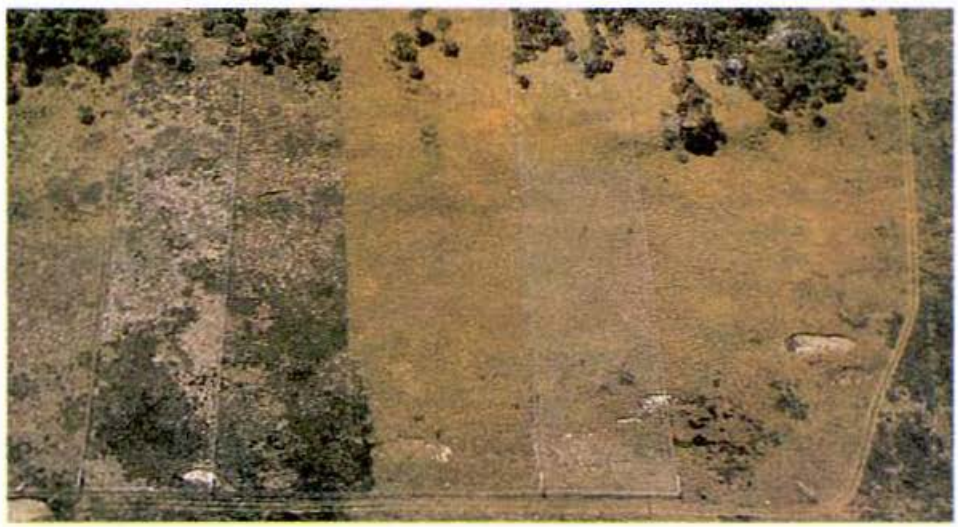
A separate study of the response of the eucalypts — predominantly snow gum and black sallee — was also undertaken.

Damaging fire

So what did all the information accumulated over the years show? First, it showed that fires — of low intensity and relatively frequent — brought about many changes.

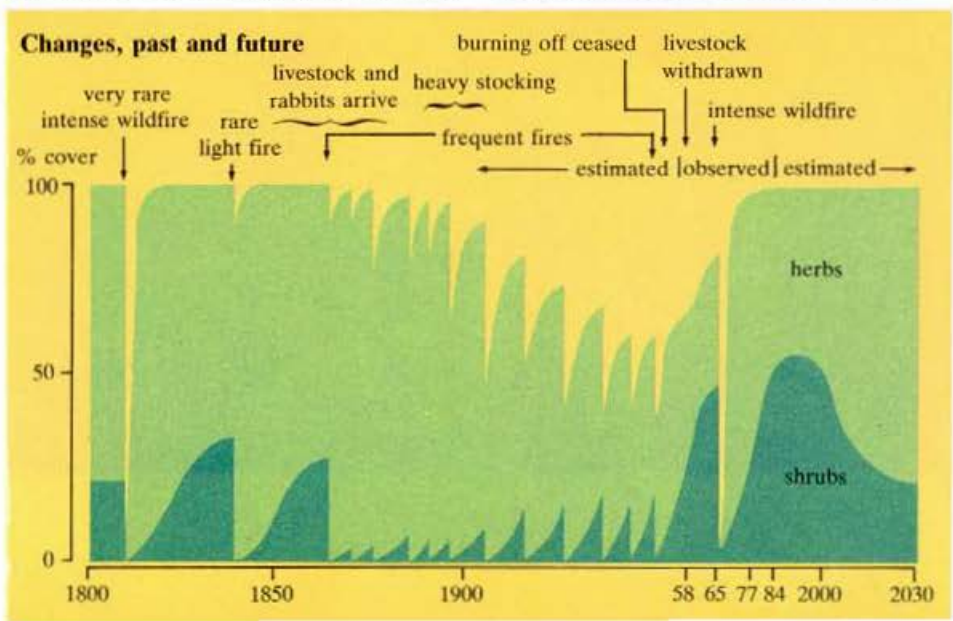
The most immediate and obvious was a substantial reduction in total biomass (although the number of species present remained almost the same). On the ungrazed plots 10 months after the first fire it was still only 2–3 tonnes per ha, one-third its former value of 7–8 tonnes per ha. However, after 4 years, the herbs had almost regained their former bulk.

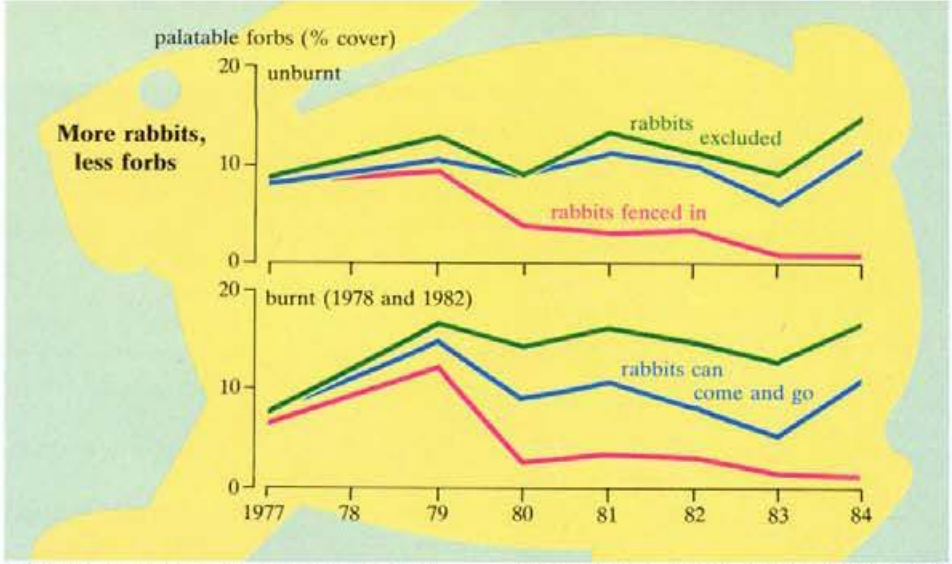
Slices of high country near Kiandra, each given different fire and grazing treatment.



Dr Costin's earlier work had shown that it requires at least 10 tonnes of herbs per ha (dry weight) — or 30 of shrubs — to prevent excessive run-off from sub-alpine grasslands and, even 12 years after the

This diagram illustrates changes that have affected plant cover in the past, and its likely evolution in the absence of fire.





Rabbits severely reduced the amount of ground cover occupied by palatable forbs. These data pertain to frost hollow, but a similar picture emerged for woodland.

previous wildfire, biomass on the study site had still not reached these levels.

Hence the latter-day scientists contend that, ideally, no man-made fires should be allowed in the high country. (In fact, no planned fires have been lit in the sub-alpine area since the early 1970s.) Another effect of fire, discussed later, is an increase in bare ground, and this should not be tolerated either.

One additional consideration is the extent to which, or even whether, frequent low-intensity burns reduce the risk of intense wildfires. Much depends on the time interval between fires.

Frequent burning, while it temporarily suppresses shrubs, can encourage their proliferation. Some years after a shrub-promoting fire, the country will become more flammable than the grassland that would eventuate if fire remained absent for decades (sufficient time for the shrubs to mature and die).

Snow gums resprouting after fire. If rabbits repeatedly eat the regrowth, a favourite food item, they can kill the tree.

The diagram on page 18 illustrates the dynamics of shrub abundance, and the factors pertaining to control burning are discussed in 'Burning question in the Snowy', an article in *Ecos* 11.

Whereas the herb layer was the first to spring back after fire, longer-lived shrubs took a number of years to reassert themselves, which they did by resprouting from the base. Interestingly, the researchers didn't observe any shrub seedlings that had been germinated by the fires they set. They presume this was because their fires were of very low intensity: the fires progressed at less than 1 m per minute, and they had to re-ignite them several times to keep them burning.

Furthermore, at no time did they see shrubs colonising intact grassland or bare ground. They surmise that, in the absence of all but very-low-intensity fires, shrub numbers slowly decrease as old plants die, and they expect Kosciusko to become less shrubby as it recovers from a past regime of livestock and frequent fire.

What allows shrubs to get the upper hand, they assert, is a combination of bare soil and reasonably high-intensity fire, which promotes germination of shrub seed.

Before about 1860, when European man

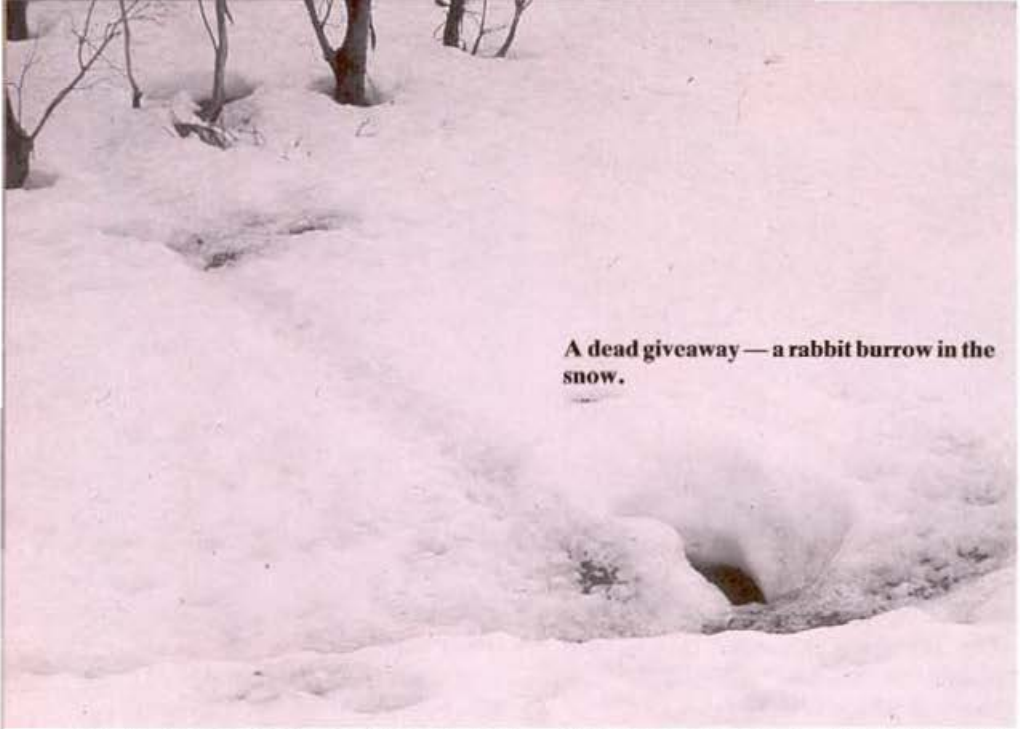
A rabbit 'lawn'.

arrived with his livestock, wildfires of high intensity were very rare, judging by the age of some isolated snow gums. Low-intensity fires probably recurred only at intervals of between 10 and 70 years. Bare soil would be rare, and shrub levels would be low (perhaps 20% of the ground cover).

However, as the state of the Park in 1958 demonstrated, the effect of livestock and frequent fire is to increase the amount of bare ground — levels of 40% or more were common when grazing leases were withdrawn. Denuded, the soil can succumb to erosion, undesirable in the Kosciusko National Park for many reasons, including the fact that this estate frames almost the entire catchment for the Snowy Mountains Scheme.

Although frequent burning kept the shrubs down, they sprouted forth everywhere after 1958, and only now are they beginning to dwindle. Fortuitously, the period of the experiment covered the turnaround period, and the scientists were

Where have all the flowers gone? Eaten by rabbits nearly every one. Stocked plot, right; protected plot, left.



A dead giveaway — a rabbit burrow in the snow.

able to document the peaking of shrub numbers on unburnt plots.

The present work found that in 1977, when the trials began, ground cover had grown to 98%. The fires set by the researchers proved that even the lowest-intensity fire bares the soil, increasing susceptibility to soil erosion.

Dr Costin's earlier work had demonstrated that soil loss can occur when the proportion of bare soil is as little as 1–2%. As a result of the first experimental fire, the rabbit-free plots contained 18% bare ground 8 months afterwards, and 13% remained bare 10 months after the second fire. And 4 years later, more than 5% of the ground was still bare.

Rabbits akin to livestock

If we have seen that Kosciusko can do without the imposition of fire, and is indeed better off free of it, then even more so is this true when rabbits are added to the equation, for in most respects they magnify the effects of fire.

A general observation was that, 4 years after fire, the total biomass on the rabbit-stocked plot was only 70% that on the rabbit-free plot. And this figure doesn't take account of the rabbits' preference for the most palatable plants, particularly the forbs.

Rabbits caused a substantial reduction in the cover and biomass of forbs. As the graph on page 19 shows, on the rabbit-stocked plots the palatable forbs (some 37 species out of a total of 106 found growing in the area) suffered a steady decline, and so at the end of the experiment they had been grazed back to about one-tenth the cover of the comparison rabbit-free plots.

In fact, the rabbits had a drastic effect on some 39 palatable species, completely eliminating nine species from their plots. These included *Aciphylla simplicifolia* (alpine celery), *Brachycome aculeata, B. scapiformis, Diuris pedunculata* (golden moths), and *Oreomyrrhis argentea* (silvery carraway). In contrast, the plots from which rabbits were excluded gained two new species, notably *Helichrysum acuminatum* (the colourful alpine everlasting).

Heavy close cropping, particularly near warrens, causes the development of rabbit 'lawns'. Rabbits also disturb the soil by digging and scratching, and are apt to deposit dung in localised areas. All these behaviour patterns greatly disturb the native vegetation.

Another observed characteristic of grazing rabbits was their fondness for eating flower heads. The photo on page 19 shows the marked difference between the stocked and rabbit-free plots in this respect. As well as detracting from the beauty of the high country, the effect will diminish seed production and may retard recovery of plants after a fire.

Recovery after a fire is also hampered by the rabbits' preference — again like the cattle and sheep before them — for eating the delectable resprouting plants. This penchant extends to trees resprouting after a fire. About one in five with basal shoots was observed to have suffered rabbit attack, in some cases leading to the tree's death. Other trees were killed by rabbits eating bark so avidly that ringbarking resulted.

With appetites filled this way, rabbits positively thrived after fire, as shown by the numbers of free-roaming ones observed on the burnt plots compared with the unburnt (see the chart).

Moreover, there is evidence that, in dense tussock and shrub habitats, rabbits depend on fire to maintain their numbers. For example, according to surveys in the 1960s by the then CSIRO Division of Wildlife Research, rabbits appear to be almost completely confined to areas of the high country that have had a history of livestock grazing and, hence, regular fire.

Once tussock grasses begin to invade rabbit 'lawns', the animals appear unable to stop the reversion to dense native grassland — unless fire opens up the vegetation.

Left alone, then, this type of country may almost rid itself of rabbits. With no fire-induced green pick, life can be very tough for these animals above the winter snowline. Heavy snowfalls and bitter conditions can almost wipe them out.

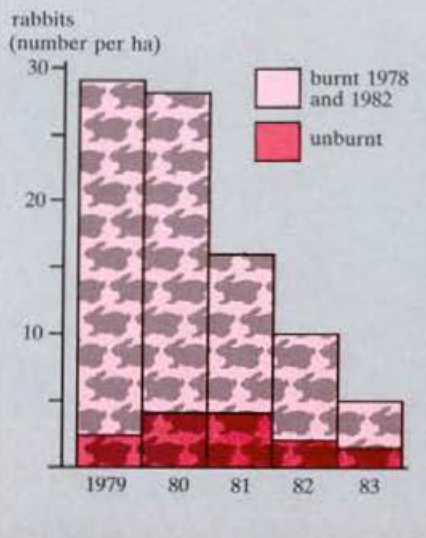
Unlike their populations in more benign climates, rabbits in snow country depend for survival on refuge in burrows, and these can be easily spotted in the snow by the dirt and dung surrounding them. Dr Leigh believes that, with a determined campaign involving a small number of workers concentrating on pockets of rabbits over several winters, the burrows could be poisoned and the rabbits exterminated.

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

Andrew Bell

On unfenced plots rabbits were much more abundant where fire had been, gauged by the number of dung pellets.

Rabbits prefer burnt country



More about the topic

Effects of rabbit grazing and fire on a subalpine environment. 1. Herbaceous and shrubby vegetation. J.H. Leigh, D.J. Wimbush, D.H. Wood, M.D. Holgate, A.V. Slee, M.G. Stanger, and R.I. Forrester. *Australian Journal of Botany*, 1987, **35** (in press).

A high-country perspective. B. Lee. *Ecos* No. 22, 1979, 24–31.