PRACTICAL CONSERVATION AND RESTORATION OF HERBACEOUS VEGETATION

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INTRODUCTION

Conservation and management of herbaceous vegetation in New Zealand is highly complex and problematic. There are many types of natural and induced herbaceous communities. Those limited by cold, drought, shade or toxicity include alpine grasslands, floras of ultramafic rocks and rock ledges, extreme coastal communities, and herbaceous ground covers of forests. Those limited by time are the successional grasslands and herbfields of riverbeds, landslides, and burnt off tussock-clad hill slopes that formerly held forest and owe their existence to disturbance. The main problems with their management arise from their vulnerability to the overwhelming number of introduced plants, co-adapted to the many foreign herbivorous mammals.

Methods and technologies for conservation and restoration of woody vegetation are well understood and rehearsed, and can be successful if resources and the will exist. The formula is relatively simple, but still needs to be learned over and over. One has to consult, plan, have a realistic view of available resources (don't bite off more than you can chew), survey and interpret the restoration site, choose the 'right' range of plants for the site (in terms of location, landform, drainage, soil), kill the (exotic) grass, mulch to keep it dead, don't let inexperienced operators loose with spray or weedeaters, and absolutely (all the time) control pests that will munch your plants as soon as your back is turned. Of course this just achieves the first stage of forest or scrub restoration. There are eventually all the epiphytes, vines, and ground cover ferns, forbs and graminoids to be established.

For herbaceous vegetation, purpose, theory, and practice are all problematic although many of the same principles apply as outlined above; but there are also instances of the opposite applying. Because of the inevitable mix of native and exotic species, particularly in herbaceous communities, the only means of sustaining the full suite of native plants, usually in association with or even dominated by exotics, is to apply a range of disturbance intensities along a 'management gradient'. At one end of the gradient are the stress-determined communities, like alpine grasslands, requiring little management other than control of exotic grazing animals and wilding conifers. For successional or induced herbaceous vegetation, exotic grasses and forbs need to be controlled by

grazing, fire (if you are on a North American prairie – and maybe some NZ situations), cutting, mowing, hand weeding, selective (safe) herbicide, or potentially biocontrol. We may also induce stress by partially shading out or droughting tall exotic grasses such as can be seen along the north-facing edges of shelterbelts. In addition, direct drilling of native grassland seed over large areas and planting of lost elements may be necessary. At the most intensive end of the management spectrum is gardening. The home-gardener can make a vital contribution to the survival and recovery of the native herbaceous flora – through creation of biodiverse rock wall, scree garden, rock garden and lawn communities. These artifical habitats act as surrogates of natural gorge, cliff, ledge, riverbed, lowland grassland, and sand dune environments. In a sense, the lawn mower becomes a surrogate sheep and the gardener a selective moa – pecking and pulling the weeds.

PATTERNS AND PROCESSES

Some may argue that because our herbaceous vegetation is either surviving happily in the mountains, is on its way to becoming forest, or is dominated by exotic species, there is no need to do anything. However, much of our biodiversity is bound up with the small plants – on the forest floor, or as epiphytic, intertussock, rock ledge, coastal dune or riverbed successional species. About 25% of the flora is largely confined to the alpine zone (Mark and Adams 1995). All of these habitats or niches are threatened by intensification of land use, fragmentation of habitat and competition or browsing by exotic species.

Furthermore, one of the fathers of modern ecology, F. Clements, also said that we should recognise all the stages of succession in understanding vegetation and, by implication, conservation must also. Clements' sere (from which the word seral or successional comes) is a representative unit of vegetation with both spatial and temporal form. In other words the sere for a region is not only the species of the 'climax' state (the ultimate mature fully developed condition), but of all the stages leading up to the climax. Accordingly, loss of the herbaceous seral vegetation from the lowlands, even if its stronghold is in the mountains, is a loss of the total representative cross section of our natural history – or the evidence for our species' ecological potentials.

Herbaceous communities are maintained by combinations of stress (resource constraints) and disturbance (resource discontinuity and damage) (Fig. 1). Stresses include cold, drought, infertility, anoxia/waterlogging, and toxicity such as from heavy metals or salt. Disturbances usually involve removal of foliage, stems, flowers, and substrate and agents include grazing, mowing, fire, flooding, and erosion. In some respects disturbance compensates for stress in terms of structural effects (both generate short herbaceous vegetation), but not species

composition. For example, a grazing marsh may look like a natural dry grassland but will be made up of largely drought intolerant, unpalatable species. Another way of looking at disturbance is as the inverse of time. The more frequent or recent the disturbance, the earlier will be the stage of succession supported. Intensity or severity of disturbance is also important.

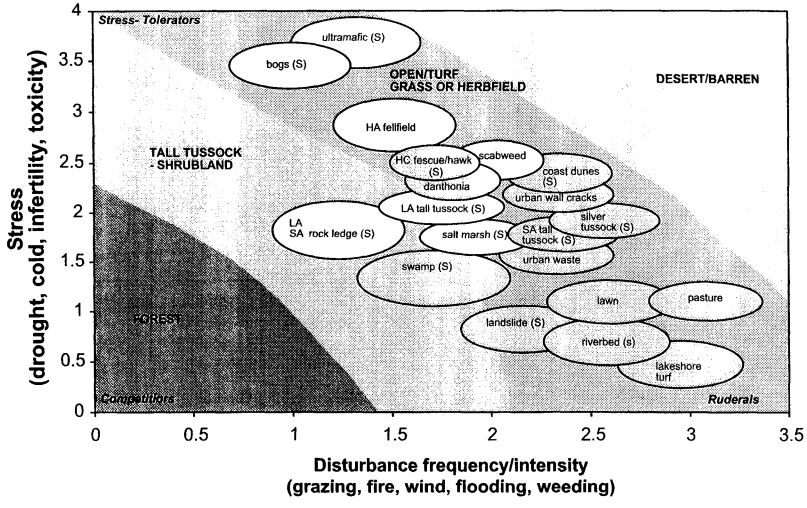

Fig. 1 A stress-disturbance matrix (adapted from Grime et al. 1988) showing the relative positions of various New Zealand herbaceous plant communities. S = potentially with shrubs. Natural, mature communities tend to occur in the upper left and induced, seral communities in the lower right.

No vegetation is static; all is subject to disturbance at some stage or at some scale. For example, there is continual grazing of all vegetation by invertebrates, whereas ancient kauri forests began life after fire, vulcanism or cataclysmic storm centuries ago. The new factor for New Zealand's vegetation that has to be taken into account is the multitude of exotic plants and animals. These exert whole new layers of competition (resource depletion or stress) and disturbance never experienced during the evolution of this land's biota. Co-existence with exotic flora is inescapable; even mountains are being invaded. For nature conservation we need to 'outwit' the introduced species where it is not practical or desirable to eradicate them. In some cases we can use them as suppressants of

other, worse weeds, or as nurseries for regeneration of native plants. Native herbs now survive only in windows of weak exotic grass competition or where the few unpalatable natives enjoy the benefits of defoliated/grazed exotic competitors. This knowledge and awareness is the key to effective management and restoration.

WHERE IN THE LANDSCAPE CAN THESE COMMUNITIES BE FOUND OR RESTORED?

The only seriously droughted environments in New Zealand are in eastern South Island and very shallow soils elsewhere. Low rainfall may be exacerbated by foehn winds and natural free drainage. But one may also artificially induce drought stress by establishing beds of coarse sand and gravel or reducing soil depth, so that the substrate has very low moisture-holding capacity, and by utilising sunny slopes of hills or embankments. Another window of stress is the north-facing edges of pine shelterbelts (able to suck up prodigious quantities of water), within the tree-rooting zone, which will generally spread beyond the extent of the trimmed canopy (Fig. 2), and especially on stony soils. This creates an even drier situation which suppresses tall exotic grasses and creates a window of opportunity for indigenous herbaceous species such as silver tussock, New Zealand broom, blue wheat grass and New Zealand groundsel (Moen and Meurk 2000).

In addition to natural environments, there are opportunities in the cultural landscape where artificially stressed and/or disturbed environments exist in association with buildings, transport corridors, gardens, etc. These new environments are becoming increasingly significant in light of the deterioration of New Zealand's natural environments.

Native tussocks are increasingly being used as landscape design features in relatively benign environments. However, it is important to recognise that one then faces difficult maintenance problems. A classic case is the use of silver tussock in the city – on traffic islands and borders. The problem is that lowland New Zealand is a forest climate and many tall exotic grasses (cocksfoot, prairie grass), and eventually woody plants, are capable of overtopping silver tussock and eventually causing its senescence. Without the stress, the more competitive species take over. As in garden situations, where growth conditions are as close to perfect as possible, the only way to protect a desired, but ecologically inappropriate, species is to spend a lot of time in the 'garden' weeding. We will come back to the domestic garden later.

Fig.2. Indigenous blue wheat grass, dichondra and New Zealand broom surviving in the window of reduced exotic grass competition over the rooting zone of a pine shelterbelt.

It is important to make the, perhaps obvious, point that the first and urgent priority is **preservation** of **all** remaining "primary" habitats. An ounce of protection is worth a pound of cure – or prevention of loss is always better. It will provide the only chance of holding onto the benchmark ecosystems, whose real complexity can only be guessed at, and the sources of biological material for future restoration work. The avoidance measures in the Resource Management Act (1991) would no doubt be more enthusiastically followed if we had to pay the real replacement cost of destruction of primary habitat – perhaps hundreds of thousands of dollars per hectare for herbaceous vegetation. Even then there is little chance of true replication as discovered after decades of prairie restoration efforts in Wisconsin (Cottam 1987; Powers 1987).

HOW – AT LARGE SCALES

We can only ever hope to 'garden' a few tens of square metres in the wild. But if we want to maintain hectares of semi-natural grassland we have to resort to rougher "bucket-chemistry" type methods. These will result in a range of combinations of native and exotic plants with sensitivities to various imposed disturbances or stresses. Large scale managed stress can be applied using trees to shade out dense grass and promote native ground cover ferns, graminoids and forbs. This may be achieved even in exotic pine forests where there are plenty of examples of native ground cover species (MacMillan 1973; Norton 1989; personal observation of ferns and sedges in Douglas fir forest in South Canterbury). Low fertility can be maintained by minimising soil disturbance, and applying pine bark mulch to promote acidification and leaching. Specific stresses may also be induced on a large scale with salt, using or excavating coarse-textured substrates, or raising the water table to waterlog topsoils.

Windows for native herbs need to be created, maintained or manipulated both by technology and by 'outsmarting' or utilising exotic plants and animals to emulate natural disturbances or reduce competition. Hard grazing (Meurk *et al.* 1989), mowing, topsoil stripping, selective herbicides, burning (I. Payton – see www.tussocks.net.nz), and biocontrol, may all have their places in particular situations. However, it is clear that presence of competitive alien flatweeds and swards will cause decline of native forbs under almost any management, whereas in irrigated and fertilised, ungrazed montane grasslands short tussocks and palatable shrubs increase (Walker *et al.* 2003).

In other cases, such as sand dunes and salt marshes, we need to give nature a chance by providing some weed-free space. Breaching causeways that ring estuaries will allow trapped wasteland to be reflooded with salt water. Salt marsh succulents are usually quick to establish on their own and, if a mosaic of islands and swales are formed, the habitat will be more complex and provide

nesting and dabbling sites for native shore birds. This has been carried out to good effect, by Andrew Crossland and Kate McCombs for the Christchurch City Council, around the Avon-Heathcote Estuary. Likewise dunes need to be free to roll inland a little to provide a window of mobile sand for our native sand-binding plants like pingao, spinifex, sand spurge, sand convolvulus, and shore sedge. At present, with pressures to lower dunes and plant them with aggressive exotic herbaceous plants like kikuyu in the north (David Bergin pers. comm.) and ice plant in the south, often the only bit of dune left is that which is frequently washed away with high spring tides. If the native plants are established higher up it is only a matter of time before the ice plant or kikuyu rolls over the top of them. Native coastal scrub (sand coprosma) and bush (akeake, ngaio, taupata) species can be used, but then the natural foredune sequence and dynamic is truncated.
(See also www.forestresearch.com/cooperatives CDVN).

HOW – AT SMALL SCALES

All the above methods will also work at small scales. It is really a matter of labour and money. The drought induction by tree roots referred to earlier is an example of a fine-scale approach; and the other applied stresses and disturbances can be used more topically.

Native plant gardening is a particular and potentially huge opportunity for operating at the small (domestic) scale. The harnessing of even a fraction of the collective energy, of the army of home gardeners in the country, would result in major increases of native plants and their associated ecosystem elements across our most populous (urban) environments. Creation of rock gardens that emulate riverbeds and gorges, mowing of biodiverse lawns starved of the chemicals and manicuring that otherwise lead to exotic grass monocultures, abundant weeding, selective (safe) herbicides, and of course planting seed-grown native herbaceous plants, will all help to protect lowland populations of many locally threatened species. And it doesn't have to look drab either (Gabites and Lucas 1998)!

WHAT THIS MEANS

We are losing our natural heritage of herbaceous and open woody vegetation at an alarming rate – the recent bulldozing of some of the last prostrate kowhai on the Canterbury Plains, along the Old West Coast Road, is just the latest known example!

It is clear that this attrition will continue if we pursue a "business as usual" policy. Or we can take a different path, salvage the primary habitat that survives, and restore it back to a viable condition. We shouldn't underestimate

the time it may take to achieve this and to integrate indigenous nature back into our cultural landscapes. It may take centuries, just as it did in England – for a new comfortable balance of nature and culture to be forged – notwithstanding the last decades of renewed degradation of rural land in some parts of Europe. However, if the opportunity is not taken now it may well be lost for good.

NEXT STEPS

Awareness of the problem needs to be raised and information about qualities and remedies widely publicised.

The procrastination must stop; action needs to be taken on protecting appropriate sites, for example one of the best candidates for a Canterbury dry plains parkland, is at McLeans Island; and there needs to be greater recognition of lowland shrublands and grasslands (even when they are diminished) in the Tenure Review process.

We need to take bolder landscape-scale management actions – that protect what primary habitat is left and tries a range of management options for sustaining them or restoring new habitats – especially in visible locations where most people who experience nature, learn from, identify with and want to protect it.

A management gradient with all possible combinations of methods of removal of impediments and supplementation of lost elements (Fig. 3) is needed. This will create windows of survival for our lowland species across their natural or potential range. The complex of floristic outcomes is hinted at in the multifactorial experiment, carried out in montane Otago, reported by Walker *et al.* (2003).

Native plant nurseries need to propagate and provide a greater range of lowland herbaceous plants (not just alpine species), together with advice on their cultivation. There are dozens of indigenous herbs that are suitable for these applications listed on the www.bush.org.nz/planterguide web site.

And we can make the most of urban gardening options at both property and neighbourhood scales.

ACKNOWLEDGEMENTS

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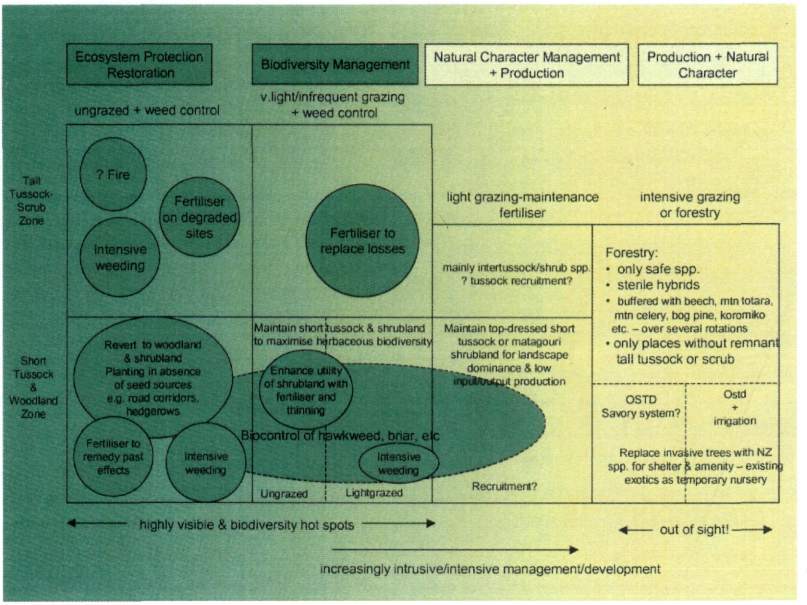

Fig. 3. A management gradient model that optimises biodiversity and production in a high country cultural landscape. Different combinations of management techniques will be more or less suitable for different indigenous and productive species along the gradient.

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Festuca novae-zelandiae is a short tussock abundant in the South Island, and extending in to the North and Stewart Islands. The closely related *F. matthewsii* is known from the South Island only. Colin Meurk's Ph D studies were related to tussock grasslands, and he remains a passionate advocate for the conservation of dwindling short tussock remnants. (del. Hugh Wilson).