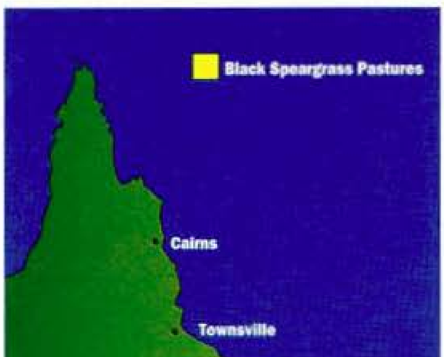
Towards a strategy for sustainable pastures

After six years of work in south-east Queensland, researchers are helping graziers to heed the warning signs of soil and pasture degradation. ***Bryony Bennett*** *outlines the new approach.*



Between Rockhampton in Queensland and Casino in New South Wales stretches more than five million hectares of grazing land that forms the backbone of Australia's sub-tropical cattle industry.

Pastures grazed by cattle in this region contain a mixture of native herbs and grasses and are commonly known as 'black speargrass' pastures. This is because they have been dominated by *Heteropogon contortus* (black speargrass).

Heteropogon is an important component of south-east Queensland's sub-coastal pastures because it survives drought conditions, contributes to soil stability, and is a relatively nutritious food source for cattle. Its dominance in the sward, considered a sign of healthy pasture condition, is therefore encouraged.

In the early 1980s, however, graziers and scientists became concerned that black speargrass, and other valuable species, were disappearing. A combination of overgrazing and dry seasons was thought largely responsible for the change. Other contributing factors may have been increased stock numbers following earlier favourable conditions, the wide-scale switch to Zebu cattle which better utilise available forage, and a shift away from regular firing of native pastures.

Another concern related to the long-term effects of oversowing native pastures with legume species. This practice raises pasture productivity, allowing more cattle to be grazed in each paddock, but what effect does it have on the persistence of native pastures?

Producers expressed concern about the 'quality' of their pastures, recognising the potential short and long-term effects on profitability and sustainability.

The GLASS trial concentrated on sustainable resource use within the context of beef cattle grazing.

In response to these concerns, a project to assess the longer term impact of grazing on black speargrass pastures was set up in 1988 by CSIRO's Division of Tropical Crops and Pastures and the Queensland Department of Primary Industries. The GLASS project, which is now drawing to a close, has been funded by the Meat Research Corporation and the Land and Water Resources Research and Development Corporation.

Project co-leader, Neil MacLeod, a rangeland economist based at the Cunningham Laboratory of Tropical Crops and Pastures, says the project has been unique for its strong focus on sustainability issues rather than on production alone, and for its involvement of people within the cattle industry from the outset.

'The project is centred on sustainable land-resource use within the context of extensive beef cattle grazing,' MacLeod says. 'We concentrated on the condition of the resource base (pasture), rather than on the condition of the produce (the stock).

'Conventionally, producers have tended to look at the condition of their cattle, rather than at the pastures themselves for an indication of pasture health and productivity. This is undesirable.

'We have found that animal production is not a good indicator of land condition. Soil and pasture changes usually well precede changes in animal production as land condition declines.

'A key message that has emerged from the project is the need to change the way resources are assessed and monitored by cattle producers.'

Changing the habits of a lifetime, or in some cases those of a number of lifetimes, is no mean feat. But evidence of the need for such change, and a framework through which it can be achieved, can provide a

Black speargrass (*Heteropogon contortus*) an important component of south-east Queensland's sub-coastal pastures.

Gazing at the ground, not the sky

Graziers can do a lot of things about the way their farms are run, but they can't do much about the weather. And although the Queensland drought has now broken in many districts, the past six years have been decidedly dry.

It was probably fitting then that drought dogged the GLASS grazing trial. The scientists could build fences, sow legumes, manipulate stock numbers and assess pasture and cattle growth. But like the graziers, they couldn't make it rain. Instead the trial site at Mundubbera experienced the driest six-year sequence since European settlement.

Project co-leader Neil MacLeod says drought both magnifies and clouds the issue of ecological risk in relation to grazing management. He says the pasture-management model generated during the GLASS trial will help graziers to address two important questions:

- Is there a long-term trend of pasture degradation, or is it because of the drought?
- Has the immediate impact of drought overshadowed what is happening in the longer term?

Although the trial wasn't set up specifically to investigate the impact of dry conditions on pastures, the drought gave a graphic demonstration of that side of the story, MacLeod says. It highlighted the risks associated with sowing tropical legumes on marginal, low quality soils and amplified the potential for severe degradation under high stocking rates.

MacLeod says while south-east Queensland's black speargrass pastures appear resilient, overstocking during drought can increase the risk of depleting the seed banks of valuable species, and of exposing soils to erosion by wind and heavy rain.

'The GLASS trial has shown that graziers can't afford to believe that drought takes the responsibility for resource management out of their hands,' MacLeod says. 'It has developed techniques to help graziers understand what actions they can take in dry conditions to minimise land degradation.

'The sentiment during drought is that there's no need to worry about the pastures because they will "come right" when it rains. This is false optimism because there is a risk that many pastures will never fully recover.'

Where the grass grows greener: cages were used in the GLASS trial to compare species yields of grazed and ungrazed pastures.

sound beginning. This is where the findings of a six-year grazing trial, the core of the GLASS project, are proving invaluable.

Mundubbera munching

The GLASS grazing trial was conducted on 400 hectares of leased land next to CSIRO Narayen Research Station, 50 kilometres west of Mundubbera on the Auburn River in south-east Queensland (see map on page 26). The trial examined the longer-term productivity and stability of pastures under a range of stocking rates, with or without improvement through the sowing of tropical legumes. It also studied the effect of spelling and fire-management regimes.

In 1989, the trial site was divided into 40 paddocks, each of which was subjected to a different stocking rate or legume 'treatment'. For six years, the total pasture yield (biomass) was recorded at the end of each growing season (autumn). From this information, annual changes in species composition for 50 key pasture species were calculated. Changes in pasture condition, animal production and returns on investment in relation to the main treatments were then analysed.

From its inception the trial was beset by drought conditions, which by 1995, had become the worst sequence of dry seasons since European settlement (see box story). The drought created some constraints such as poor initial establishment of legumes, but also provided a unique opportunity to document changes of a greater magnitude than might have been seen in wetter seasons.

The trial revealed that both financial and ecological risk were increased with the augmentation of black speargrass pastures with tropical legumes. While legumes could be successfully established (even during drought), their presence led to high grazing pressure on the grass component of the pasture. This caused an increase in annuals at the expense of perennial grasses. Such pastures are difficult to manage due to the unpredictability of short-lived species, and may be vulnerable to further degradation.

While the legumes did result in significant increases in animal production, the cost of their establishment would in many cases be unjustified, particularly in dry seasons, such as those experienced during the trial.

Despite the poor results in relation to legume sowing, MacLeod refers to the exercise as one of 'intelligent failure'. 'This project tells both sides of the story by showing what is successful and what is not,' he says. 'Farmers can learn from both.'

Also recorded during the grazing trial was the effect on pastures of four different stocking rates (0.1, 0.3, 0.6 and 0.9 steers/ha). As expected, the highest stocking rate was found to depress productivity per animal. In the trial's last year, annual liveweight gain at the highest stocking rate was almost 60 kilograms per head less than at the lowest stocking rate. Higher stocking rates also increased the risk of pasture degradation.

An example of this risk is the finding that increasing stocking rates progressively reduce *Heteropogon* seed production (see graph). Germinable seeds are necessary for species to recover from grazing, so depletion of the seed bank is an early indication that populations may be at risk. Recovery may be possible, however, if the heavily-grazed adult plants are allowed to seed in subsequent years.

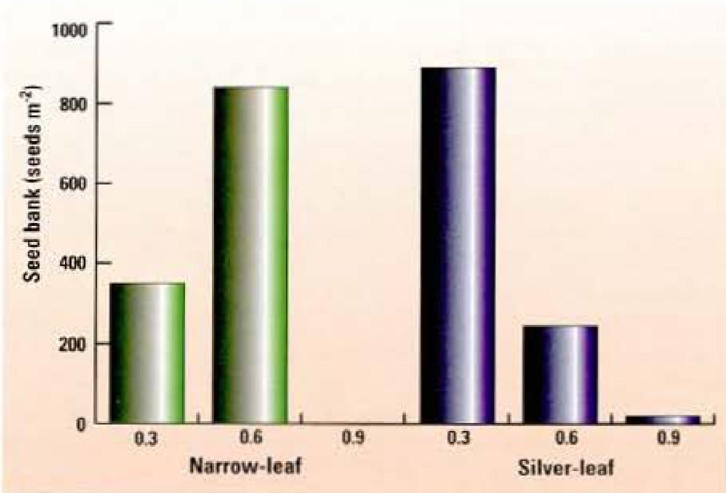
Determining the extent to which *Heteropogon*-dominant pastures are able to recover from high stocking rates, and at what point the damage is irreversible, is central to devising new guidelines for grazing management. Based on the results of the GLASS trial, a model representing changes in composition of native pasture with increased grazing pressure has been developed. After some fine-tuning, this 'state-and-transition' model will be available to help graziers monitor and assess the condition of their own pastures, and to warn them of the need for remedial action.

In managing their cattle, graziers respond almost intuitively to certain triggers or 'management thresholds' that signal the need for a particular action. Calves are weaned when they reach a certain age; herds are treated for parasites according to seasonal conditions, and young cattle are sold at particular stages of growth. A grazier who did not act on these triggers at the optimum time would be taking an economic risk.

Evidence of the need for timely action in relation the pasture management, however, has tended to be less tangible, MacLeod says. A general view among graziers is that there is no harm in delaying decisions to relieve excess pressure on pastures. The belief that 'I can do something about it someday', often means waiting until cattle lose condition, he says.

This view is linked to an outdated belief that as pressure continues, vegetation change occurs, but if released, the system will move back to its former, stable and desirable condition. Were this theory applied in the context of pasture degradation, the solution to overgrazing would be as simple as undergrazing (resting the paddock).

Germinable seed bank (seeds per square metre) of *Heteropogon* in Spring 1994 at three stocking rates (steers per hectare). Depletion of the seed bank is an early indication that populations may be a risk.



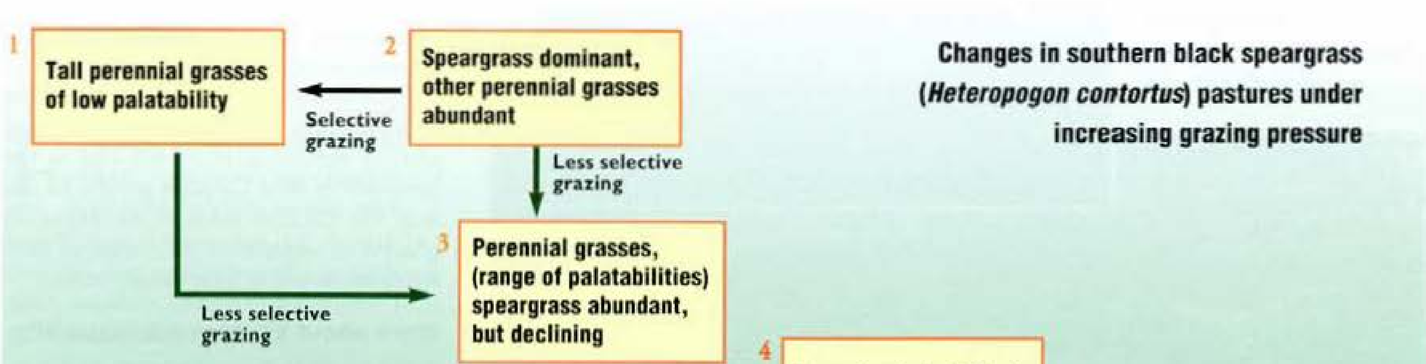
But vegetation change is not necessarily continuous and reversible. Rather, it may be rapid or slow and irreversible and/or take a number of pathways. The state-and-transition model developed for *Heteropogon* pastures during the GLASS project recognises this inescapable quirk of nature. Importantly for graziers, the model also identifies thresholds that can be used to prompt decision-making in relation to pasture management.

Defining change

The model outlines five separate states of pasture composition, each representing a different level of grazing pressure. Some states also identify situations in which intervention may be needed, either to prevent further degradation, or return the land to its former condition (this might include easing grazing pressure, spelling the paddock, or implementing a fire strategy). In effect, the model gives graziers guidelines for assessing ecological risk.

States 1 and 2 are associated with the lowest grazing pressure. They are dominated by tall perennial grasses which protect the soil and generally have high productivity and water infiltration potential (90-100%). However, State 1 grasses tend to be avoided by grazing animals and, therefore, these grasses tend to accumulate when grazing pressure is low and animals can afford to be selective of what they eat. *Heteropogon* in fact does better when it is grazed lightly and tolerates low to medium levels of grazing. Sustained high grazing pressure, however, is damaging to it.

State 2 of the model is characterised by the dominance of *Heteropogon*, the presence of a wide range of species, and a high capacity for water infiltration (90-100%).



Changes in southern black speargrass (*Heteropogon contortus*) pastures under increasing grazing pressure

As the grazing pressure increases, due either to drought or high stocking rates, *Heteropogon* decreases, annuals increase, and water infiltration drops to as low as 40%.

Beyond State 2 the transition of an area to progressively higher numbered states indicates increasing pasture and soil degradation. In botanical terms, the major indicators of pasture degradation are a decrease in *Heteropogon* and an increase in annual species. These changes are accompanied by increased water runoff, and ultimately to soil loss, particularly at higher stocking rates. This has the potential to reduce pasture and animal productivity in the longer term.

Annual and short-lived plants have been associated with highly disturbed vegetation (such as heavily-grazed pastures) in many studies. The significance of this trend is that pasture composition is likely to become more unstable, as population turnover is more rapid than in perennial vegetation. Reduced water infiltration is likely to compound the trend towards lower productivity as plants are unable to access the water that runs off.

Species composition changes in response to grazing pressure because at low stocking rates, the cattle eat only the plants which are tastiest while higher stocking rates force a wider range of plants to be eaten. Also, each species responds differently to grazing pressure due to variations in their biology. For example, short pasture species may be promoted by grazing because they tend to survive high grazing pressure (such as in states 4 and 5). These tend to be less productive and animals run out of feed more quickly on these states.

Transitions from higher to lower numbered states, or pasture 'recovery', are not well understood. In general, reversal of the trends are driven by a release of grazing pressure in the presence of propagules: seeds or remnant plants that have been suppressed. In two instances, however, this may be insufficient to effect a transition to improved pasture condition. For example, some of the species in states 4 and 5 are very competitive and if *Heteropogon* is lost, it may not recover. A transition from these states (4 and 5) to higher states is thought to be unlikely to be achieved by resting. Other direct management interventions such as fire or re-seeding may be necessary.

Thus the state and transition model outlines for graziers the consequences of failure to identify and respond to critical times for pasture management.

'To be sustainable in the longer term, graziers must maintain the integrity of their soil and pasture resources,' MacLeod says. 'The aim of this research has been to generate for graziers a means of identifying when a shift in pasture condition is about to occur or is under way.

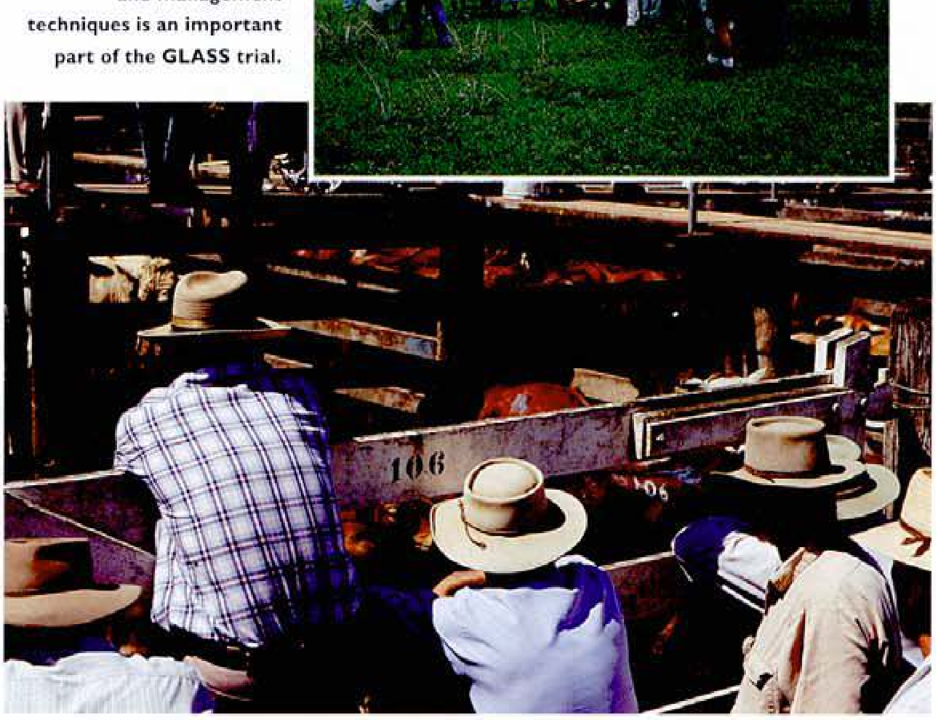
'The trial results confirm that persistent, heavy pasture use leads to changes in species composition and soil that result in reduced productivity and riskier economic returns. They also indicate that pasture and soil change precedes animal change, and that the change may in some cases be irreversible.

'Monitoring pasture composition, particularly *Heteropogon* populations, and appropriate corrective management may therefore be necessary to protect the pasture/soil resource. Factors such as reduced seed production and plant survival, or increases in other annual and short creeping perennial grasses, may also be useful early warning signs of degradation.'

For many graziers, applying the state-and-transition model on farm will require taking a more disciplined approach to pasture observation. This will involve observing the prevalence of indicator species at key sites and learning to recognise threshold conditions.

To help graziers improve their pasture management skills, the findings of the GLASS trial have been woven into an extension program developed by Queensland Department of Primary Industries staff at Bundaberg. The program includes a series of Property Management Planning modules which are presented at regional workshops for farmers and farm consultants. New modules on ecological and economic risk associated with land management in southern black speargrass pastures are being added to the program.

The research findings are also discussed with producers at open days held at the trial site, at agricultural events and at the invitation of local Landcare groups. In this way the GLASS team is encouraging graziers to understand the nature of their resources, as well as their hungry beasts.



Graziers can pick a top-priced pen of steers at the saleyards, but can they recognise the signs of pasture degradation on the farm? Educating graziers about pasture monitoring and management techniques is an important part of the GLASS trial.

More about pasture sustainability

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