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CONSERVATIVE RANGELAND MANAGEMENT IN AUSTRALIA
A PERSONAL VIEWPOINT

W.H. Burrows

Queensland Department of Primary Industries, Rockhampton 4702

ABSTRACT

Australia's rangelands are viewed as renewable natural resources which have, in large part, deteriorated considerably since grazing commenced with domestic livestock. It is stressed that this decline in pastoral value is continuing and it is suggested that the situation has for too long been glossed over by landholders and administrators, as well as rangeland research and extension workers.

Some of the factors contributing to rangeland deterioration are discussed and hopes for predictive modelling of these systems outlined. The danger of adopting systems which purport to increase animal production through increased stocking rates is highlighted, while monitoring our rangelands is endorsed as a high priority. Finally, some prescriptive suggestions are made for rangelands in this country within an overriding philosophy of more responsible land management, with under-utilisation rather than over- use proposed as the basic objective.

INTRODUCTION

The principal point of David Wilcox's address to the last ARS conference was that "controls on land used for grazing in the rangeland areas of Australia are best exercised by the land users themselves" (1). Since this has mostly been the case since European settlement, one would have to say that, in large part, land users have been unsuccessful in their management (cf. Cobar - Byrock area in New South Wales (2,3), Mulga zone and the Burdekin catchment in Queensland (4), Mitchell grasslands converted to thorn scrub (5), Gascoyne catchment in Western Australia (6), *inter alia*).

It would be very easy and convenient to blame the land users themselves for this documented degradation (in terms of plant cover, composition and animal production) but Wilcox (1) further notes a corollary to his principal point viz. that landholders should be given, firstly, the guides which they can use to direct their management practices, and, secondly, the objectives which they can strive towards from time to time.

The provision of these aids to management is the responsibility of the administering authorities for rangelands (who in most part are also the landlords), their research staff and extension officers. If scientists and advisers have the responsibility for supplying information in a form which landholders can use (1) it may be concluded, from the present state of the rangelands, that these professionals do not have the necessary information; or they have transmitted it poorly, and/or it has not been accepted or adopted by the end user. Any fair assessment would conclude that the major fault lies with the provision and dissemination of information. For example Queensland has by far the greatest area of rangelands (native pastures grazed by domestic stock) of all the Australian states (7), and yet has not one extension officer solely dedicated to giving management advice for its native pastures!

Our failure as a profession is a failure to be both predictive and prescriptive. These are not unexpected traits in such a young science, especially one operating in such a highly erratic and variable climate. But time is running out. The nation is demanding sustainable use of its renewable resources (8) and research, extension and administrative wise we will have to deliver. What can be done?

MANAGEMENT PERSPECTIVES

Soil is the basic resource of rangelands. Vegetation is usually resilient if the soil is unchanged, but a degraded soil lowers the productivity of the system indefinitely (9). Soil is especially vulnerable to degradation where the nutrient pool is concentrated in the surface horizon. Management of rangelands hinges on the maintenance of the natural vegetation or its augmentation/restructuring, rather than its complete replacement. The persistence of the desirable perennial plants is a primary objective, since mistakes with these species are not easily corrected. The overall purpose of management is to preserve the rangelands, not to exploit them. No economic argument justifies the known diminution of renewable natural resources. The present and the future must be as one! (9). Emphasis must therefore lie in the prevention of degradation, rather than its rehabilitation.

Managerial influence is greatest at those times when the environment is at its most extreme. These are the times to seize the opportunities and avoid the hazards (10), such as the rare confluence of high rainfall, woody weed establishment, large fuel loads and the capacity to burn.

Rangeland management is based on an understanding of how the rangelands function and on the flow of information on their status, so that management can be informed and responsive to current conditions (9). The principal determinants influencing the dynamics of rangeland systems are rainfall, soil type, tree-shrub/grass ratio, herbivory and fire. Of these the most potent tool available to the manager, in space and time, is the adjustment of grazing pressure or stocking rate.

<u>Stocking rate</u>

In a remarkably astute observation the Icelandic parliament is reported to have passed a law centuries ago that the farmer should place only that number of animals on the land, such that the removal of one animal would not result in increased production of the rest of the herd (11). If such a policy were followed in our rangelands we would be carrying about half the number of sheep and cattle as are presently grazed! It would also have an alarming effect on our immediate balance of payments and could result in devastating wildfires from time to time.In practice graziers have tended to determine their stocking rates on the number of animals that can be safely carried in the 'dry' season. This means that for much of the year pastures may be considered understocked and much research effort has been devoted to improving the quality of dry season feed (for example, by use of urea-molasses or grain supplements, augmenting the pastures with legumes etc.) In tropical areas such practices can have a major impact on the stability of grasses by placing increased defoliation pressure on them as they recover in the early 'wet' season (12,13). The use of native (for example, *Acacia aneura*) or introduced (for example, *A. nilotica*) fodder trees when pasture quality declines has a similar effect in the drier rangelands. Other husbandry practices such as provision of permanent water points and fencing to confine stock to set areas contribute to unusually high grazing pressures (number of animals per unit of feed) being placed on pastures at certain times. Compounding all these influences is the dominating effect of climate, which alone can account for an eight to ten fold fluctuation in annual productivity of some of our arid grasslands (14,15,)

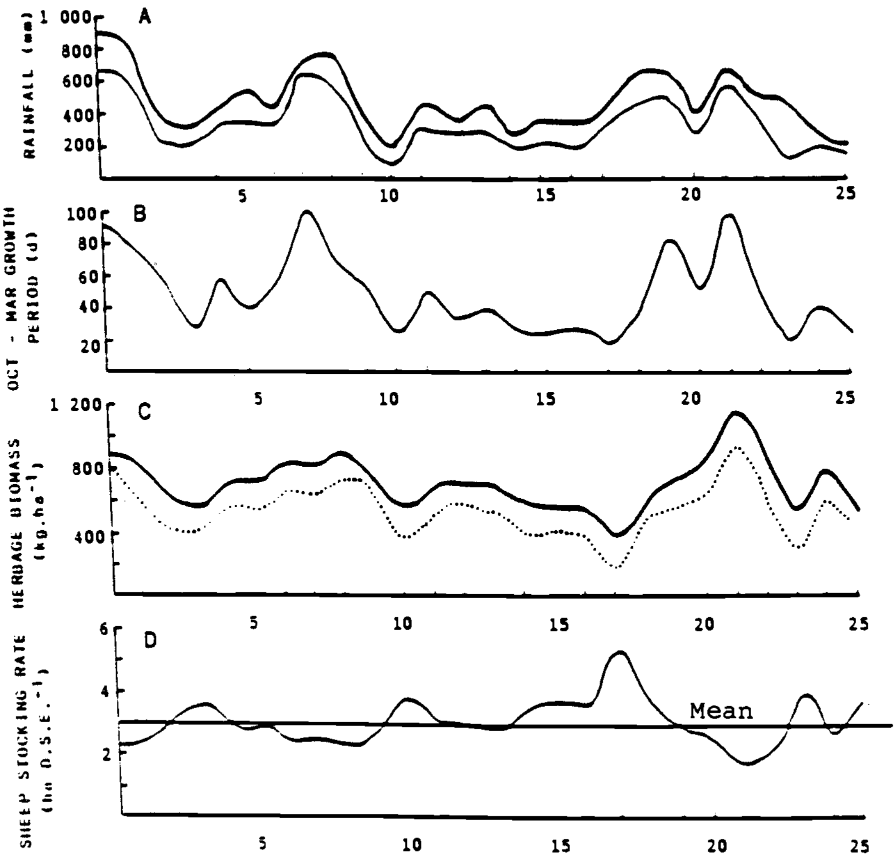

Fig. 1. Analysis of historic rainfall records for Charleville, Queensland, for the period 1955 - 1980. Model output shows interrelationships between: (A) rainfall, April - March (▬▬) and October-March (——): (B) length of October-March growing period (soil water balance output): (C) live herbage biomass produced over the October-March period(·······) and total herbage biomass available at the end of this growing period (▬▬) and (D) derived values for annual stocking rate. Analysis based on a constant ground storey basal area of 2.5% and 20% herbage utilisation by sheep. (After Christie and Hughes (66)).

Thus any set level of stocking that attempts to achieve maximum production will incur over-utilisation and heavy grazing in times of drought and gross under-utilisation after periods of high rainfall (16, Fig. 1). Such observations have led Savory and Parsons (17), *inter alia*, to claim that most rangelands are "understocked and overgrazed" and to use this as one of their sales pitches to promote short-duration grazing systems. In fact most objective studies of such systems have failed to show that they give any better animal production than continuously grazed systems at **equivalent** stocking rates (see Box). Increasing stocking pressures under any guise, is the antithesis of conservative rangeland management in Australia today.

What approach should be used? As the environment becomes harsher, the philosophy of adjusting stocking rates to match the feed available becomes more and more logical. Stock numbers should be determined by the amount of feed produced per unit area of land, **not** on the unit area of land (18). Heady (19) suggests it is probably best, as a managerial expediency, to combine fixed stocking of the nucleus herd or flock with flexible stocking of other animals, to obtain the most rapid response during the favourable seasons and the least damage in the poor seasons. This does not preclude seasonal resting of certain paddocks to favour seed set of desirable species, to encourage establishment of recovering or augmented pastures or to build up fuel for managed burns.

Short-duration grazing vs continuous grazing systems

(Conclusions of Bryant *et al.* 1989)* (67)

- Short - duration grazing resulted in a decline in individual animal performance.
- Short - duration grazing did not improve diet quality of grazing animals.
- Short - duration grazing did not appear to improve animal distribution.
- Short - duration grazing produced no positive influence on germination or establishment of seeded or native plants.
- Short - duration grazing resulted in soil compaction.
- Short - duration grazing did not improve range condition at the same or higher stocking rates compared with continuous grazing.
- Short - duration grazing did not increase grass or forb standing crop.
- Short - duration grazing resulted in an increase in animal yield per unit area grazed if stocking rate was increased. This is true regardless of grazing strategy.
- Dramatically increased stocking was not feasible.
- The level of economic input and management intensity required to establish and operate a short - duration grazing system is excessive, except to increase the ease or flexibility of livestock handling. The return did not justify the expense.

* Based on the research of Texas Tech. University with greater - than - recommended stocking under short - duration grazing systems compared with continuous, yearlong grazing on sandy and sandy loam soils in semi arid climates.

The concept of adjusting stock numbers to the feed available is best illustrated by the "take-half, leave-half" philosophy first popularised in the United States of America. Variants on this theme have been proposed for short grass prairie by Bement (20) and in Australia by Jozwik, Nicholls and Perry (21). More recent Queensland based work (22,23,24,25) has determined stocking rates from preselected utilisation levels for feed available at the end of summer. Levels of utilisation chosen range from 20-40% depending on types of pasture and animals grazing them. Systems grazed at this level of use will have the forage supply composed of new season's growth from rainfall (an uncontrollable management factor) and carryover from the previous season (a controllable management factor). Carryover is an important supplement to the small amount of new biomass produced - should the succeeding growing season be low in rainfall. As a general rule the higher levels of utilisation are recommended with cattle, and for sheep on the more productive pastures, while lower levels are advised on less productive sites - "cattle have the decency to die when the grass does, but sheep do not".

Pressland and McKeon (26) suggest that simulation models of plant growth can be used to monitor pasture production and the number of domestic livestock that can be supported. Calculated safe stocking rates (based on 30% consumption of summer growth) for the ensuing year can be compared with the actual stocking rate (Fig. 2) to indicate whether stock numbers and pasture production are in balance. An example is presented for the Dalrymple shire in the Burdekin river catchment in Queensland.

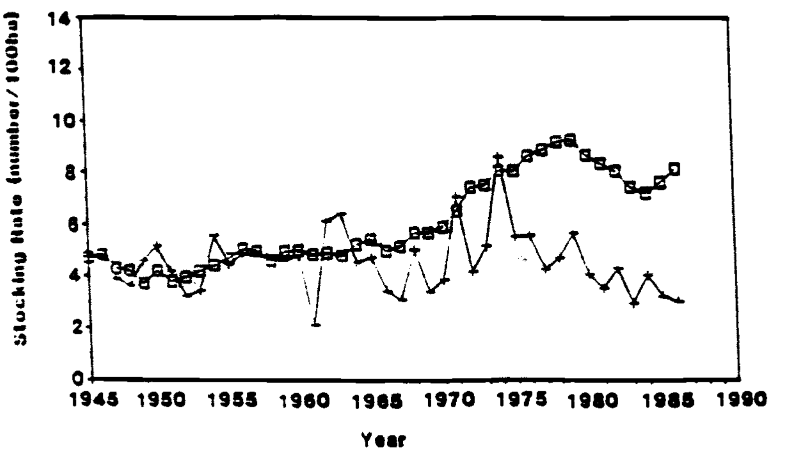

Fig. 2. Actual stocking rates (□) of beef cattle in the Dalrymple Shire, Queensland, compared with safe stocking rates (+) estimated from the GRASP model. Based On McKeon *et al.* (54).

The economics implicit in pastoral stocking rates were lucidly detailed by Bill Holmes at the last ARS conference (27). He noted that maximum profit occurs at a stocking rate somewhere between that which maximises gain/head and gain/ha and that from a practical perspective this point may be ill defined - so that near maximum profitability may occur over a comfortably wide range of stocking rates (cf. 28). Despite these observations many graziers continue to stock heavily and this is accompanied by ongoing deterioration of our pastoral lands (29,30). While there are many cogent reasons for this practice a very plausible explanation advanced by Danckwerts and King (31) is that the productive value of rangeland is relatively insignificant when compared with its investment value. This argument appears to have some substance in the Australian context (witness the rural outcry against the introduction of capital gains tax in 1985) and, if it is accepted, seriously challenges the *raison d'etre* of the range management profession and the ultimate conservation of our rangeland systems.

Range assessment and monitoring

There is little dispute that excessive grazing pressure has led to the decline of productive potential in much of this country's pastoral lands since European settlement - but how that desirable potential (condition) can be defined in a manner intelligible and acceptable to range managers (32) remains a matter of some debate. Any assessment method must at least establish whether the site is deteriorating or not, as a result of past and current management (33).

Both ecological (climax) and productivity based methods of condition assessment have been advocated in Australia. However the climax based approach (for example, 34) does not cope with woodlands or shrublands where the natural succession in the absence of fire is towards a woody state of low value for grazing. Also 'pristine' reference sites have often borne only tenuous relationships to the area being assessed. In chenopod shrublands sheep productivity is little different in areas where the chenopods remain dominant ('climax') compared with adjacent sites where they have been removed by past overgrazing (35,36,37). No difference in beef production is postulated when heavy grazing converts *Heteropogon contortus* dominant pastures to *Bothriochloa pertusa* dominant systems in north-east Queensland (R.J. Jones, pers.comm.). Thus there may not be a direct relationship between change in species composition and change in production as assumed by Dyksterhuis (38).

Measures which emphasise productivity have been canvassed by Christie (39) and Wilson (40). Christie noted that in infertile *Acacia* shrublands grass establishment was a slow, difficult process so that in these situations maintenance of basal cover was more important than composition as a determinant of range condition. He further demonstrated a direct relationship between the basal cover of perennial grasses and pasture yield. Vegetative cover is also a strong determinant of run-off and erosion hazard (41). Unfortunately basal cover is difficult to measure with speed and accuracy over large paddock areas.

In my experience range managers are more concerned about maintaining a minimal basal cover on infertile, water shedding sites and more concerned with promoting desirable plant composition on fertile, water absorbing sites. Wilson (40) notes that an appropriate system for range condition assessment is one which combines both resource value and range condition concepts. The land use, production and conservation objectives for the land are used to set the standard and the scale of departure from that standard.

The critical point of management interest is the initiation of long term degrading changes in vegetation and soil. If a manager can detect such changes before the undesirable trend has proceeded very far, it may still be technically reasonable and economically feasible to deal with the situation (16). To this end administrative and research groups responsible for much of Australia's rangeland areas have initiated monitoring programs (for example 42,43,44,45). Queensland's monitoring program is expanding significantly but remains essentially research based at this time.

The sheer size and number of holdings in our rangelands limits our ability to ground truth all paddocks or management units. The involvement of the individual manager in the monitoring program in Western Australia is therefore to be commended (46). For broader administrative purposes it seems inevitable that more reliance will be placed on satellite remote sensing incorporating soil or vegetation related indices in a GIS (47,48). Nevertheless monitoring sites should be seen firstly as an educational and only secondly as an administrative tool. They should be concentrated where there is greatest risk of degradation (9).

I have some reservations with 'fixed' interval recording of monitoring sites. Unless successive recordings are made under similar climatic conditions misleading conclusions can be reached, especially with respect to the herbaceous layer. Recordings which are related to 'unusual' perturbations (for example, rainfall well above or below average, fire, significant change in grazing pressures, mechanical disturbance etc.) are also likely to be more enlightening than fixed interval samples.

Such event related data will give the manager the useful capacity to predict and act upon trends, rather than simply documenting them after they have occurred. This approach is convergent with the state-and-transition model of rangelands (10) which depicts these communities as catalogues of alternative states and catalogues of possible transitions between states. This model seems especially pertinent to our rangelands where the tree/shrub-grass balance often dominates management concerns.

<u>Woody plants, grass and fire</u>

Burrows *et al* (5) have recently examined the tree-grass continuum for three major rangeland types in north-eastern Australia - eucalypt woodlands, mulga shrublands and Mitchell grasslands invaded by the exotic *Acacia nilotica*. In all these situations only two stable states appear to exist under grazing - grass dominance or tree/shrub dominance. The grassland with many shrub seedlings is considered transient (cf. Fig. 3). Burrows (32) concluded that for mulga shrublands in this area the trend is now unidirectional towards increased dominance by woody plants. Implicit suggestions that fire can be used to convert a dense woody plant cover back to open grassland (49,50,4,10) fail to take into account the extreme competitiveness of the woody plants (51), the consequent insufficiency of fuel to carry a hot fire, the low frequency of opportunity to burn (52), coupled with the large soil seed banks of target species (for example, 53).

It is claimed that fuel loads of 800-1000 kg/ha are necessary for ground fire to carry under normal dry season conditions (5). Under such circumstances change in shrub canopy from zero to only 10% can reduce the potential fire frequency in mulga lands from 64% to 13% of years respectively (52).

These observations are not to gainsay the fact that fire can be an extremely cost effective method of controlling shrub build-up in rangelands. However we should concentrate on promoting the achievable, rather than the very remote possibility of reducing thick stands through managed burns. Thus fire should be seen as tool to be targeted at initial stages of invasion or increase in woody plant populations - preferably when the plants are less than two years old.

It is probably unrealistic to expect graziers to recognise and appreciate the significance of the early phases of woody plant build-up. This certainly appears to have been true in the case of *Acacia nilotica*, which germinated and established over large areas of Mitchell grasslands in north-west

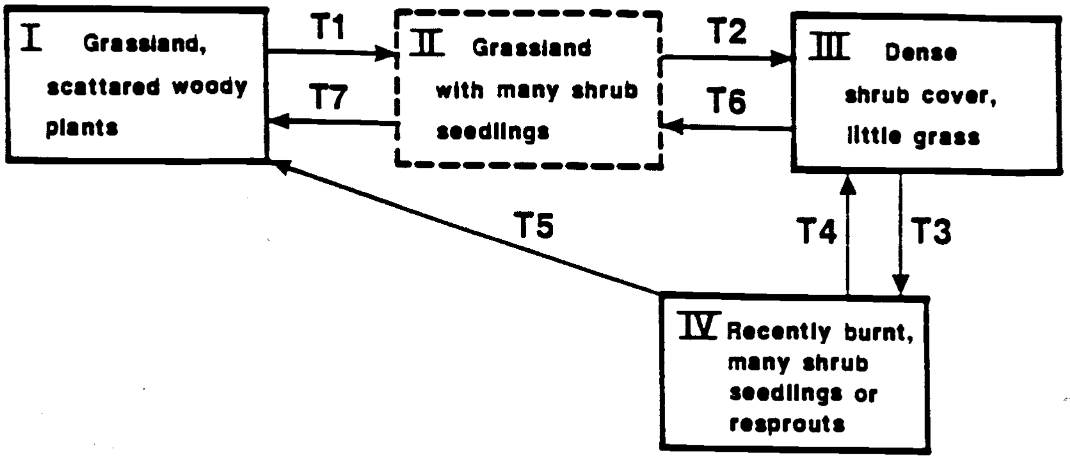

Fig. 3. State-and-transition diagram for semi-arid grassland/woodland in Eastern Australia with potential for shrub increase. States are detailed in boxes with states II and IV considered transient. Based on Westoby *et al.* (10) (q.v. for explanation of transitions).

Queensland, following the sequence of exceptional rainfall years in the mid 1970s. At this time grass was also abundant while the potential of the *A. nilotica* plants to compete with the grass layer in the future (5) was not appreciated. The effect of woody plant competition on grass and animal production is less apparent in the good seasons (Table 1) and lulls the grazier into a sense of complacency.

Table 1. Derived stocking rates (ha/adult beast) for *Eucalyptus populnea* communities before and after tree removal. Data are presented for good (pasture yield 3000 kg/ha in the open) and poor (pasture yield 2000 kg/ha in the open) seasonal conditions and based on consumption of 30% of the annual pasture growth. After Burrows *et al* . (5)

	Basal area of trees (m^2/ha)	Pasture yield (kg/ha)	Derived stocking rate (ha/beast)
(i) Good season			
"Treed"	15	1040	13
"Cleared"*	3	2050	5
(ii) Poor Season			
"Treed"	15	260	50
"Cleared"	3	1300	10

* "Cleared" areas have 20% of the original tree population retained.

Monitoring sites referred to earlier and maintained by rangeland research and extension groups can be seen in this context as important sentinels, providing the early warning of potential system 'flips' to new states dominated by undesirable trees and shrubs. The state-and-transition model of Westoby *et al.* (10) highlights the need to identify the 'triggers' which push systems over thresholds into new stable states. Most such triggers are man controlled (for example, sustained heavy grazing, removal of fire, regular use of nutritional supplements, use of fodder trees during drought etc.) but, while man cannot control the major overriding influence of climate, encouraging developments in its prediction could impact significantly on management options in the near future.

Rainfall, models and prediction

McKeon *et al.* (54) note that high annual variability in rainfall (55) and temperatures (56) and the lack of understanding of the mechanisms causing this variability have led Australian ecologists to a re-active, rather than a predictive approach to ecosystem management. Meanwhile, Taylor and Tulloch (57) have shown that a range of biological phenomena associated with recruitment, distribution and survival, were strongly affected by extreme rainfall events, approximately half of which were associated with extremes of the Southern Oscillation. The Troup Southern Oscillation Index (SOI) is calculated as the normalised pressure difference between Tahiti and Darwin (58).

Negative indices of the SOI (below -5 for example, half a standard deviation), especially where they persist for several months, are associated with ensuing **low** rainfall in Eastern Australia. The reverse applies when strong positive indices are recorded. The ways in which such improved climatological understanding can impact on management of rangelands are comprehensively reviewed by McKeon *et al.* (54). They point out that decision rules derived from short-term experiments (for example, stocking rate and burning policies formulated in the 1950s, compared with the 1960s) should be evaluated in the context of historical SOI recordings which are available for more than 100 years of records. Such analyses are in accord with Westoby et al.(10) who suggest that research emphasis needs to be placed on estimating probabilities - frequency per year, per decade or per century - of the climatic circumstances relevant to particular transitions.

Management decisions in rangelands have to be evaluated against a background of uncertainty in seasonal climate (and price). One way this can be achieved is to combine pasture production models with historic climatic data for different zones to predict likely feed availability under different management scenarios (5). For example, a simulation model has been developed (25) to incorporate the effects of trees on forage production into a woodland management strategy, evaluation package. A water balance and pasture production submodel (59) estimates pasture production in the absence of trees from soil data and daily climate, using empirical relationships from field trials. Equations from Scanlan and Burrows (60) are then used to simulate the effect of different tree densities on pasture production. Thus given soil type, rainfall, initial tree basal area and grazing utilisation level, it is possible to compare alternative development strategies for north-eastern Australian eucalypt woodlands.

Pasture production models, once validated, remove the shackles of site specificity from research and extension so they are certain to play an increasing role in rangeland management. Coupled with the local knowledge and considerable experience of landholders they will strongly contribute to expert systems and related computerised decision support (for example, Rangepack (8), Grassman (25)) for the 1990s and beyond.

DISCUSSION AND CONCLUSIONS

In a prescient statement to the 1986 ARS conference Brian Walker suggested we need to question the long-term objectives of rangeland production - Is it simply to produce more meat or wool? If so, who wants it? (61). Such questions would certainly find a sympathetic ear with Australian wool growers in 1990.

I believe that the time has come for rangeland research and extension professionals to be frank with themselves, landholders and managers, administrators and the politicians who have the ultimate responsibility of passing on the land as heritage from one generation to the next. And the message is simply this - that for much of our rangelands we are presenting to the next generation, land in worse condition than we received it from the previous one. That where rangeland productivity has been maintained it has resulted from technological and infrastructure developments outside of, yet perhaps negatively impacting on, the 'health' of the land itself. That the detrimental effects observed are not necessarily restricted to the poorer land systems.

Take my own working life in Queensland. Here the mulga lands have continued on their inexorable path to dominance by woody weeds (62) and it seemingly matters little that we have a good understanding of the processes involved (51,63). While it is easy to see in hindsight that this pattern was clearly set, as early as the turn of the century (2), the same cannot be said of what has happened to the Mitchell grasslands. Much of this range in north west Queensland, described as 'treeless' in Orr's major review published in 1975 (64), is now converted to dense thorn scrubland dominated by *Acacia nilotica*, as earlier outlined (see 5). To my mind it is undoubtedly the worst plant invasion of our rangelands since prickly pear.

As if this were not enough we have managed since the 1970s to overgraze and place at great risk the herbaceous layer of enormous areas of the Burdekin river catchment (41). Finally, in all the regrowth control and woodland clearing activities undertaken in Queensland (estimated at c. 500 000 ha annually), very little is carried out with due acknowledgment of environmental concerns - especially for the fragmentation of wildlife habitat and maintenance of essential reserves etc. (65).

I have deliberately confined these observations to my own state, perhaps presenting this litany of disasters as a self cleansing process? But I am certain that there are on-going transitions in rangeland systems in all states which none of us would be proud of. Is it because the range management profession has such a close and necessary relationship with landholders and managers that we tacitly accept the piffle that is so regularly propounded by grazier organisations that "the owner/manager knows what is best for the land", that "he can be relied upon to do the right thing"? Or is it that in not admonishing pastoralists for documented deterioration we avoid having to sheet the blame home to the real culprits - the range management profession and land administrators who have observed it happening and not stood up to be counted?

The vast majority of Australia's rangeland remains as leasehold. What other landlord would tolerate the deterioration of its assets such as do the landlords of our rangelands?

When we come to terms with these questions, we will be in a position to act on remedies and to base future management on prediction and prescription, rather than reaction. The promise of the future is that for the most part our understanding of rangeland processes is now quite good - the gift of a very young profession to its inheritors. What they require is the confidence and the will to do what we have not. Some prescriptive suggestions follow, based on the earlier part of this address:

- Adjust stock numbers to the feed available, for example, base animal carrying capacity at any point in time on the feed present per unit area of land and **not** on the area of land. Do this by maintaining a nucleus herd or flock with flexible stocking of other animals.

- Limit utilisation levels to a maximum of 40% of feed produced each year. Where this figure is consistently exceeded enforce legislative controls. (By corollary, rainfall x soil x pasture production models should be developed as a matter of high priority for all rangeland types where they do not currently exist).

- Avoid grazing systems which are claimed to maintain or improve animal performance solely by increasing stocking rates.

- Perennial species are the preferred pasture types in rangelands, providing the environment is not inimical to their growth and persistence. This is so even if animal production is little different from ephemeral pastures which replace them.

- Be careful not to overgraze perennial pastures at the start of the growing season or at the breaking of drought.

- Spell pastures from time to time, if necessary, to allow seed set of desirable species, to encourage establishment of recovering pasture or to build up fuel for managed burns.

- Management which contributes to breakdown of soil structure and fertility should not be tolerated.

- The desired primary combination of perennial pasture and soil surface stability suggests that range condition assessment should be strongly weighted towards maintaining a good vegetative basal cover, rather than plant composition.

- Permanent monitoring sites should be an essential feature of all rangeland administration and research. The sites should be re-recorded in response to known perturbations, rather than at fixed time intervals.

- Such monitoring sites should be of sufficient size to act as ground truth to complete coverage provided by remote sensing systems.

- Historic climatic data should be used wherever possible to estimate probabilities of obtaining results from set piece experimentation over wider time frames.

- Greatest effort in woody weed control should be placed on limiting expansion or thickening up of woody weeds, rather than attempting to ameliorate the impact of existing dense stands.

- Research and extension agencies should assume greater responsibility in warning landholders of times when woody plants are significantly increasing in density so that fire can be considered as possible control in the seedling phase, when it is most effective.

•Regrowth control and woodland management should treat target species 'on a face' to minimise regeneration, but retain at least 20% of the area as interconnected strips for shade, shelter, timber reserve (if applicable) and wildlife habitats.

It has been beyond the scope of this review to delve into the very important impacts that soil type differences and wildlife populations have on range management in this country. However, a more complete set of prescriptive suggestions for Australian rangelands, than presented above, has recently been provided by Foran *et al.* (8). Such recommendations need to be adjusted and modified to suit regional conditions. Where clear signs of degrading systems are in place, with no apparent technological and economic remedy, we should be prepared to exclude the land from pastoral use and to look at alternatives. Included amongst these should be 'non-use'. After all this is the present fate of about one third of Australia and was, apart from the previous 150 years, effectively the condition for the previous millennia! Despite initial appearances this is not a nihilistic view, but rather one given with confidence. I believe that we now have the knowledge and technical ability to manage our rangelands for sustained productivity - but we do not have the administrative capacity at present to ensure that this result is always achieved. Until this deficiency is overcome, under - rather than over - use is the best alternative for the rangelands and Australia's future.

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