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<td>Whilst Maintaining Good Land Condition</td>
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Introduction to the

Pigeon Hole Project

By Steve Petty

There is significant potential to further develop the capacity and profitability of the northern Australian pastoral industry. Research, the BTEC and good cattle prices have facilitated a major improvement in management and herd productivity over the last 15 years in the region, with leading producers branding in the order of 80-85 per cent calving percentage and keeping herd mortalities to less than 2 per cent. Although the average herd productivity has significantly improved, rising costs (fuel, labor, helicopter costs, etc) and land appreciation (land values have more than doubled in the last 10 years) is continuing to apply pressure to further improve returns. Stocking rates are one of the key factors driving the productivity and profitability of many northern pastoral businesses. If stocking rates can be sustainably increased the northern pastoral industry will continue to be economical.

There are many properties in the Victoria River region of the Northern Territory that only graze an average of approximately 12.5 per cent of annual pasture growth (Dyer et al. 2003) or average stocking rates of 8 to 10 AE’s/km², where recent research suggests 20 per cent can be sustainably grazed (Cowley et al. 2007). To a large extent this is because of the low level of infrastructure development (fences and waters) and the uneven way cattle use the landscape. Increasing stocking rates by spreading cattle out and making more efficient use of the existing pasture therefore appears to be a logical development. But will increasing pasture utilisation negatively affect the nutritional intake of cattle, and result in a decline in animal productivity with little improvement in productivity per unit area?

In many cases, simply increasing stocking rates under current levels of development has resulted in a decline in nutritional intake, decline in productivity and pasture degradation adjacent to the water points and low levels of pasture utilisation further from the water points. This is a function of poor water distribution and a low level of infrastructure development. paddocks need to be developed to allow the native pastures to be more uniformly grazed. The scale and level of development required to achieve this is not clearly understood.

Australia’s rangelands support much of the country’s biodiversity resources (Woinarski and Fisher 2003). The level of pasture utilisation and level of development have both been shown to adversely affect the maintenance of biodiversity in these native pasture systems (Fisher 2001). If this region is to be more intensively developed to allow higher average levels of pasture utilisation the biodiversity impacts need to be more clearly understood and strategies to manage any negative impacts need to be developed and tested.

Economic modeling of commercial data demonstrates the potential positive impacts of higher average stocking rates on the profitability of northern pastoral businesses. A significant assumption in the economic modeling is that the costs per unit animal can be maintained at current levels or decreased. Strategies to reduce the operating cost per unit animal need to be investigated under intensified systems.

The Pigeon Hole project in the Victoria River District (VRD) of the Northern Territory is currently investigating the potential to increase stocking rates, the infrastructure developments necessary to allow this, and the economic and ecological implications. Investigating issues such as these requires a whole-of-business approach to R&D given the impact these factors have on all aspects of management.
in a pastoral business. The results from the project will be developed into management principles to help other producers in this region more intensively develop their extensive pastoral businesses.

The Pigeon Hole Project
The Pigeon Hole Project is a joint venture research project underway at Pigeon Hole station in the VRD. This project is a five-year study (2003-2007) being conducted at a commercial scale (308 km²) with 3,000 to 5,400 cattle. The $6.4 million project has been developed and jointly funded by Heytesbury Beef and Meat and Livestock Australia through the Partners in Innovation Program. The agencies supporting the project and undertaking the research are the CSIRO, NT DNRTEA, NT DPIFM, Tropical Savannas CRC and the University of Queensland. These agencies have also contributed significant resources to the project. The results from the project will be published in 2008. Some preliminary results are presented within this report.

Implications from the grazing systems research.
Intensive development of this region will allow producers to more efficiently and sustainably utilise the existing native pastures. In other words we can consistently increase the paddock stocking rates without ‘flogging’ the country.

More intensive grazing systems, such as rotational grazing and cell grazing have the potential to allow producers to increase utilisation rates and stocking rates beyond that achievable under a set stocked system. The cell grazing systems appear to be too intensive for this environment, where rotational wet season spelling systems appear to be more practical.

Results to date at Pigeon Hole suggest wet season spelling will sustain at least a 28 per cent utilisation rate. This is a stocking rate of approximately 25 to 30 AE’s/km² in an average pasture growth year on the VRD basalt based black soil pastures. More research is required to understand if higher utilisation rates are sustainable in this environment.

Can intensified systems maintain a low cost of production?
A range of strategies to reduce the cost of production have been tested and the impact on operating cost monitored. These strategies include:

• Installation of a bore monitoring system using telemetry to reduce the cost of monitoring the additional water points under more intensive development. There are no conclusive results to date.
• The use of water medicators to reduce the cost of supplementation. The cost of supplementation has been reduced from $32 per head per year to $12 per head per year. This includes the capital cost of the medicator units.
• Utilising additional fencing to reduce the mustering costs. The mustering costs have been reduced from $10/hd to $2.25/hd.

References
Grazing Systems: Practical Management Tips and Animal Production

Preliminary Outcomes

Lindy Symes, Heytesbury Beef, Pigeon Hole Station, Katherine, phone 08 8975 0786

Key Points

- Intensive development appears to work, is practical and appears to be sustainable
- Preliminary results suggest that wet season spelling can be an ultimate compromise between the highly intensive cell grazing paddocks and large scale commercial paddocks
- The two ends of the scale were: a) Cell Grazing (paddocks average 1.3 km²) and b) Racecourse (57 km²)
- The cell grazing system proved to be too intensified and required higher levels of skilled staff and higher input cost
- Racecourse paddock (57 km² and set stocked) was too large, as it required larger cost in mustering per beast and data suggests that utilisation was not as even across the paddock (see paper by Leigh Hunt)

Table 1: The stocking rates (AE/km²) and the actual utilisation percentages for the Pigeon Hole project trial paddocks. Utilisation is calculated as the percent of standing forage in May that is consumed, using a theoretical intake based on animal numbers in May

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<tr>
<td>Brolga pdk</td>
<td>15% Util</td>
<td>22</td>
<td>9</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>12</td>
<td>13</td>
<td>17</td>
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<td>Sandstone pdk</td>
<td>20% Util &amp; 2km GR</td>
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<td>Dead Cat</td>
<td>40% Util</td>
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<tr>
<td>Barra</td>
<td>1 km GR</td>
<td>9</td>
<td>7</td>
<td>17</td>
<td>14</td>
<td>15</td>
<td>19</td>
<td>27</td>
<td>22</td>
<td>23</td>
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<tr>
<td>South Stevens Creek</td>
<td>3 km GR</td>
<td>34</td>
<td>5</td>
<td>14</td>
<td>17</td>
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<td>15</td>
<td>18</td>
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<td>2 wp pdk</td>
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Table 2: The branding percentage for each of the trial paddocks.

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<td></td>
<td></td>
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<td>Year</td>
<td>1st Rnd</td>
<td>2nd Rnd</td>
<td>Year</td>
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<td>46</td>
<td>22</td>
<td>68</td>
<td>36</td>
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<td>20% Util &amp; 2km GR</td>
<td>2131</td>
<td>64</td>
<td>13</td>
<td>77</td>
<td>43</td>
<td>35</td>
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<tr>
<td>Bauhinia</td>
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<td>47</td>
<td>15</td>
<td>62</td>
<td>57</td>
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<td>39</td>
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<td>2002</td>
<td>45</td>
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<td>59</td>
<td>47</td>
<td>33</td>
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<td>32</td>
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<td>Cell Grazing</td>
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<td>71</td>
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<td>14</td>
<td>62</td>
<td>44</td>
<td>38</td>
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</table>

The data shows the branding percentage per paddock over the years 2004 to 2007, with an average calculated for each treatment. The percentages vary significantly across different paddocks and years, indicating the need for strategic grazing management to optimize pasture utilization and livestock management.
Table 3: The unadjusted and unedited weight gains from indicator steers and indicator spay heifers for the duration of the trial.

<table>
<thead>
<tr>
<th>Table 3: The unadjusted and unedited weight gains from indicator steers and indicator spay heifers for the duration of the trial.</th>
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<tr>
<td><strong>Paddock</strong></td>
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<tr>
<td><strong>PASTURE UTILISATION PADDOCKS</strong></td>
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<td>Brolga pdk</td>
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<td>Sandstone pdk</td>
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<td>Bauhinia pdk</td>
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<tr>
<td>Villiers pdk</td>
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<tr>
<td>Dead Cat</td>
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<tr>
<td><strong>GRAZING DISTRIBUTION PADDOCKS</strong></td>
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<td>Barra</td>
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<td>South Stevens Creek</td>
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<td>North Stevens Creek</td>
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<tr>
<td>Racecourse</td>
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<tr>
<td><strong>GRAZING SYSTEMS PADDOCKS</strong></td>
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<tr>
<td>No. 13</td>
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<tr>
<td>Bullock</td>
</tr>
<tr>
<td>Cell Grazing</td>
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<tr>
<td>Control</td>
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<tr>
<td><strong>AVERAGE OF ALL PADDOCKS</strong></td>
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</table>
Wet Season Spelling

- 3 x 5 km² paddocks
- During the wet season two of the paddocks rested for half of the wet season each, the other paddock grazed for the whole of the wet.
- Closure of paddocks was determined by amount of rainfall and pasture growth that had occurred
- All paddocks were opened up for all of the dry season
- Average utilisation of pasture grown was 28 per cent
- Lessons learned from this trial indicate that paddock rotation and wet season spelling is potentially valuable in this environment.

Cell Grazing System

- Does not appear to be economic at the Pigeon Hole site, but may provide other benefits at other sites.
- There was no evidence of pasture decline or improvement during the trial
- Average utilisation of pasture grown was 25 per cent
- Average branding per cent and weight gains were lowest in this treatment
- Was impractical during wet season on this particular soil type
- Skilled staff was an issue, so could not send any person down to shift the cows
- Animal behaviour took time to work itself out, as the cows were not used to seeing humans so often and the use of electric fencing and enclosed watering points. It took some time, sorting cows out that were not suited to this environment and sorting out human shortcomings in animal handling
- Many mistakes were made at the start, but was running smoothly by the end of four years.
Figure 3: Some results of the crude protein percentage of the faecal samples collected monthly from each of the trial paddocks and then analysed by NIRS.

Figure 4: Some results of the non grass percentage of the diet as predicted by NIRS from faecal samples collected every month from each of the trial paddocks.
Figure 5: The effects of shifting cell grazing cows through a gateway in late March 2005.

Figure 6: The effect of controlled wet season grazing (left side) in the cell grazing paddocks.
Perennial Grass

Productive native perennial grasses are the cornerstone of the northern pastoral industry, with their continued survival enhancing the ongoing sustainability of the industry. This report details the first year of a study investigating the influence on perennial grasses, of two aspects of grazing management that are within the control of the manager. These are:

1. **Period of spelling** or resting the pasture from grazing. Spelling paddocks is recommended to encourage the ongoing survival of healthy robust plants. Spelling early in the growing season promotes vigorous plants, and late spelling encourages better reproduction. Research from north Queensland has shown that spelling the pasture for the first 6–8 weeks of the wet season enabled up to 50 per cent of the pasture yield to be grazed, with either maintenance of the dominant, important perennial grasses, or the recovery of degraded pastures. Spelling only for the first six weeks of the wet season could pose management problems, so as well as this early wet season spelling the study is also investigating late wet season spelling and entire wet season spelling.

2. **Defoliation rate** (or potential utilisation rate), of 20, 30, 40, 50 and 60 per cent of the leaf height, calculated by measuring the total height of the leaves of each plant. The relationship between leaf height and biomass is being investigated.

Three perennial grasses were studied, hoop Mitchell grass (*Astrebla elymoides*) and curly bluegrass (*Dichanthium fecundum*), both species preferred by cattle, and feathertop wiregrass (*Aristida latifolia*), an increaser species usually avoided by cattle. Twenty plants of each species were subjected to the different experimental treatments (period of spelling and defoliation rates — see Table 1) at two locations. Twenty control plants were also included. These, as with the defoliated plants, were clipped to a standard height of 10 cm at the beginning of the trial and at the end of the growing season with the cut part being dried and weighed to determine the yield over the season. The defoliation treatments were applied by clipping individual plants to the specified height at the relevant time to simulate grazing (see Table 1), and drying and weighing the clipped parts. Although this study did not involve the use of cattle, it aims to make recommendations on defoliation rates and spelling times and hence grazing management.
Measurements of perennial grass taken during the trial included:

- Number of plant mortalities,
- Change in the live area of plants at their base i.e. at ground level (commonly referred to as basal area). Basal area is considered a good indicator of the health of the plant,
- Reproductive potential as indicated by number of plants flowering, and
- Total yield harvested over a growing season.

The results presented are for the 2005/06 growing season, and should be considered preliminary, with the study to continue for another two seasons.

**Plant Mortality**

The different species responded quite differently to the period of spelling and defoliation rates (see Figures 1 and 2). Small bluegrass plants showed up to 10 per cent mortality in the early and late spelling treatments, even though the controls exhibited no deaths (Figure 1). Bluegrass exhibited far greater

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**Table 1. Plants defoliated (X) to heights of 20, 30, 40, 50 & 60 per cent to simulate grazing and spelling periods, shaded boxes represent clipping to a standard height of 10 cm.**

<table>
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<th>Feb 06</th>
<th>Mar 06</th>
<th>Apr 06</th>
<th>May 06</th>
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</tbody>
</table>
mortality than Mitchell grass, which was greater than wiregrass. The smaller controls of the latter two species showed around 2.5 per cent mortality. The larger plants (Figure 2) displayed far fewer deaths than the small plants and their controls exhibited no mortality.

Change in basal area

For all species, the overall trend in basal area over the 2005/06 growing season, was generally a decline (Figures 3, 4 and 5), with only a few minor increases recorded. The reduction in basal area tended to increase with higher defoliation rates, but did not appear to be influenced by time of spelling. Declines were most pronounced for wiregrass (Figure 3) where up to a 61 per cent reduction was recorded, with the control showing a decline of around 9 per cent.

The change with bluegrass (Figure 4) was less clear, although spelling for the entire wet season produced a smaller reduction in basal area than either early or late spelling. At a 30 per cent defoliation rate basal area was reduced by less than 3 per cent. This compares with a 1.5 per cent increase shown by the control. The higher defoliation rates tended to produce larger declines in basal area.

While a few treatments (early spelling with 30 per cent defoliation and late spelling with 30 per cent defoliation) showed minor increases in Mitchell grass basal area (Figure 5), the most consistent trend (reduction of less than 8 per cent) was in the entire wet season spelling treatment at the 30 and 40 per cent defoliation rates. This only slightly exceeded the decline displayed by the control. As for the other species, the higher defoliation rates tended to produce larger declines in basal area.
Reproductive potential
Mitchell grass was not observed to produce any flowers over the entire growing season. Bluegrass was observed to be a prolific flowerer needing only a couple weeks after rain or defoliation to produce flowers. Wiregrass was between these two extremes, producing plentiful flowers, but needing greater periods of time than bluegrass. Spelling for the entire wet season seemed to favour flowering in both bluegrass and wiregrass while defoliation rates higher than 40 per cent tended to reduce flowering. The percentage of control plants flowering at the end of the growing season generally exceeded any of the treatments.

Yield
For all species, the cumulative yield harvested over the entire growing season tended to increase with higher defoliation rates, with the control producing the least yield. No spelling strategy produced an increase in yield.

Discussion
The results presented are from observations over only one growing season and treatments need to be continued for a longer period. However, during the 2005/06 growing season the mortality of the smaller perennial grass plants, at all defoliation rates, was much greater than the larger plants, while period of spelling did not seem important.

Conclusion
Based on data from the 2005/06 season, to minimise declines in perennial grass basal area for this growing season, spelling for the complete wet season would be suggested with around 30 per cent defoliation. The consistency of the plant responses across a number of seasons needs to be determined to make longer-term recommendations.
Options for Managing Grazing Distribution

Leigh Hunt, CSIRO Sustainable Ecosystems, Darwin. Email: Leigh.Hunt@csiro.au; phone: (08) 8944 8485

Introduction

It is widely recognised that where paddocks are large and water points far apart cattle use the land unevenly. As a result, some pasture goes unutilised while other areas are grazed quite heavily. This uneven use can mean lower livestock production than might otherwise be possible, and land degradation in heavily used areas. Achieving more uniform use might improve livestock production through improving the effectiveness of pasture use and help manage grazing impacts on the pasture and soil. Investigating options for improving grazing distribution was one component of the Pigeon Hole Project.

Aims

The two primary aims of the grazing distribution work were:

• to assess how effective reducing paddock size or alternatively installing additional water points in large paddocks are at achieving more uniform grazing of the landscape by cattle. Of particular interest was whether it was possible to encourage cattle to use parts of the landscape where abundant forage occurs but are generally ‘under-utilised’.
• to assess whether more even grazing of the landscape by cattle is beneficial to cattle production and land condition.

Table 1. Average home range for cows grazing in three developed paddocks over four six-month periods (different cows used each time), and for a single cow in a typical commercial paddock.

<table>
<thead>
<tr>
<th>Paddock</th>
<th>Paddock area (km²)</th>
<th>Number of waters</th>
<th>Average home range (km²)</th>
<th>Approximate percentage of paddock used by individual cows (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed paddocks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small</td>
<td>9</td>
<td>1</td>
<td>8.1</td>
<td>90</td>
</tr>
<tr>
<td>Medium</td>
<td>34</td>
<td>2</td>
<td>25.6</td>
<td>75</td>
</tr>
<tr>
<td>Large</td>
<td>57</td>
<td>5</td>
<td>33.5</td>
<td>59</td>
</tr>
<tr>
<td>‘Typical’ commercial paddock</td>
<td>149</td>
<td>3</td>
<td>64</td>
<td>43</td>
</tr>
</tbody>
</table>
Methods

To address these aims we compared how cattle used three paddocks of different size and number of water points. The study paddocks had the following configurations:

- A paddock of 9 km$^2$ (small) with one central water point;
- A paddock of 34 km$^2$ (medium) with two widely-spaced water points (waters about 4 km apart);
- A paddock of 57 km$^2$ (large) with five water points (average distance between waters about 3.5 km).
- The layout of the paddocks is illustrated in Figure 1 (previous page).

We assessed the use of these paddocks by cattle by fitting some cows in each paddock with GPS collars (which record where the cattle are in the paddocks every hour). The impact of cattle grazing on the pasture was assessed by twice-yearly evaluation of pasture condition. The paddocks were stocked with cows to achieve a utilisation rate of approximately 20 per cent (approx. 15 AE/km$^2$).

To provide a comparison between the developed paddocks at the Pigeon Hole study site and the situation on many properties we are also currently examining how cattle use a more typical commercial paddock. The paddock we have chosen is Lochart paddock on Mt. Sanford, a 49 km$^2$ paddock that has two permanent waters and a water hole.

Results

Use of paddocks by individual cows

Based on the results from the GPS collars we found that smaller paddocks result in more effective overall use of the landscape because in smaller paddocks most cows use almost all the paddock. This is because by subdividing the landscape cattle obviously are confined to a limited area and have less opportunity to explore and go where they choose. As paddock size increases, use of the landscape by individual cows becomes less uniform even when additional water points are installed. This is illustrated in Table 1, which shows the percentage of the paddock used (determined from the average home range size for cows in each of the three paddocks). The home range is the area used by cows as they go about their usual daily activities of foraging, resting and watering.

<table>
<thead>
<tr>
<th>Paddock</th>
<th>Approximate distance from water at which use declined (km)</th>
<th>Percentage of GPS fixes within this distance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>1.9</td>
<td>98</td>
</tr>
<tr>
<td>Medium</td>
<td>2.2</td>
<td>85</td>
</tr>
<tr>
<td>Large</td>
<td>2.6</td>
<td>85</td>
</tr>
</tbody>
</table>
Although use of the largest paddock with five water points is less effective than for the smaller paddocks, the home range in the largest paddock is still smaller than for the typical commercial paddock. The only result we have so far from that paddock showed the home range was approximately 64 km² (which is about 43 per cent of the paddock). This suggests some degree of development will produce more effective pasture use than is currently being achieved.

**Overall use of paddocks by the herd**

Overall use of the larger paddocks with multiple waters might be more effective than it appears from just considering the home range size of individual cows. This is because the areas of a paddock used by different cattle do not necessarily overlap – some cattle concentrate on certain areas while others concentrate elsewhere. Consequently, rather than use of the larger paddocks being about 60 per cent, for example, it can be up to about 90 per cent if use by the whole herd is considered (see Figure 2). However, with large paddocks, managers have a much lower degree of control over grazing distribution and there is the risk that some areas can experience very high grazing pressure if the majority of cattle choose to graze there.

The distance from water at which use by the herd declined provides an estimate of the likely optimum grazing radius for water points in larger paddocks. In the smallest paddock the herd essentially used the entire area within the paddock (i.e. right up to the fences). In the 34 and 57 km² paddocks where the distance from the water points to the fences was generally greater, use was not constrained by the fences. The distance at which use by the herd declined markedly in these paddocks (see Table 2) suggests that grazing radii should not exceed about 2.5 km (i.e. no more than 4-5 km between water points) to maximise grazing use of the landscape.

**Effects on livestock production and the pasture**

Despite the differences in grazing use of the landscape, at this stage we are yet to see any obvious benefits for livestock production and land condition. However, this might be a consequence of the relatively short time the treatments have been in place. Also, benefits might be more apparent in poor years.

**Other considerations**

Based simply on the cattle distribution results from the GPS collars it would appear that smaller paddocks are to be preferred. However, as paddock size is reduced costs for fencing and new water points increase, so a compromise is needed between achieving more uniform use and the capital investment required.

Also, small paddocks do not eliminate uneven grazing since areas with preferred plant-soil associations still tend to be grazed more heavily than other parts of a paddock. These areas can include patches of red soil within the more common black soils, and creek lines (riparian areas) where more palatable plants often occur or plants remain greener for longer during the early dry season. There is also a preference for previously grazed areas (see below). Careful management of grazing impacts in these areas is still required in smaller paddocks.

**Factors determining grazing distribution**

Although overall it seems we have improved the effectiveness of use of the landscape this is somewhat misleading. An examination of the key factors that determine grazing distribution in the paddocks suggests that we have not been particularly effective in increasing the use of areas of the paddocks where there is abundant palatable forage. In fact, the primary determinants of grazing distribution are the location of water and a preference for areas that have been previously grazed. These areas tend to be dominated by annual grasses and forbs (but not including annual sorghum) and have lower than average pasture biomass. It might be expected that cattle should choose to use areas with higher pasture biomass. I suggest that the reason this is not the case and that instead the cattle often choose to use areas with lower pasture biomass is related to the quality of pasture available. Many annual grasses and forbs can be of higher nutritional value (nitrogen and energy) than stemmy perennial grasses that have been left ungrazed. Thus it appears the cattle are trading-off pasture quantity for quality.

A preference by herbivores for areas that have been previously grazed, have lower pasture biomass and a greater proportion of annual plants (i.e. areas with potentially higher pasture quality) is not unique to northern Australia. A similar result has been reported for domestic
cattle, buffalo and wild herbivores in other countries. Because of this preference by herbivores, grazing distribution patterns are self-sustaining. Our failure to substantially improve the use of those areas in our study paddocks with more abundant forage may explain the lack of effect on livestock production and pasture response.

Guidelines for improving grazing distribution

Taking into account our findings and the expected cost of infrastructure development, we suggest the following guidelines as a reasonable compromise between effectiveness in improving grazing distribution and cost. Naturally these guidelines will need to be adapted to suit the particular circumstances of individual properties.

1) Subdividing large paddocks is more effective than installing additional water points in a paddock in achieving more uniform cattle distribution across the landscape, although costs are higher with subdivision.

2) A paddock size of 30-40 km² should provide a good compromise between achieving more even grazing distribution and cost.

3) If possible, paddocks of this size should contain two evenly-spaced water points. At the stocking rates typical of the VRD this means there would be about 250-300 head per water point. The distance between water points should not exceed approximately 4 to 5 km (grazing radius of no more than about 2.5 km).

4) When positioning fences and water points consideration should be given to the location of land types and pasture characteristics. In particular, to maximise the use of a paddock, water points should be located away from areas that have a history of grazing.

5) Additional management techniques should be adopted to enhance the effectiveness of infrastructure developments such as reducing paddock size and installing more waters in improving grazing distribution. Because of the self-sustaining nature of grazing patterns there is a need to attract cattle to new or less used areas within paddocks either by providing feed supplements or altering the attractiveness of the vegetation. The strategic placement of lick blocks and the use of fire are examples of useful techniques. Fire can be used to remove stemmy unpalatable growth from perennial grasses and stimulate nutritious regrowth. It can also be used to reduce the patchiness in the vegetation, so that all areas are of similar attractiveness to cattle. However, grazing must be carefully managed following fire because perennial grasses can be easily killed by grazing during the early stages of regrowth. Ideally, burnt areas should be rested from grazing immediately following fire and until some pasture biomass has accumulated.

Conclusions

These results suggest that more uniform use of the landscape by cattle can be achieved more effectively by subdividing large paddocks than the installation of additional water points in these paddocks. However, because of the costs involved a compromise between these two alternatives is required. Also, the strategic placement of lick blocks and prescribed fire should be used to enhance the effectiveness of infrastructure developments in improving grazing distribution. Regardless of the techniques used for spreading out grazing pressure, monitoring grazing impacts across paddocks will remain important because cattle will still tend to use preferred areas within paddocks more than others, even in quite small paddocks.
Introduction
The Australian Agricultural Company (AAco.) in collaboration with the Northern Territory Department of Primary Industry, Fisheries & Mines (DPIFM) have been investigating the effect on reducing grazing pressure by spreading it more evenly throughout the large paddocks that are common in extensive pastoral regions.

Method
A 536 km² paddock was divided into two paddocks. Cattle in the control paddock are managed under traditional continuous grazing practices. The treatment paddock operates under an alternating watering location management practice. Cattle are moved around the treatment paddock by only having one watering point within the paddock operating at any time. The new watering points were created by turning existing troughs at bores off and pumping the water to new troughs approximately four km away in areas traditionally not grazed.

Results and Observations
Grazing Impact
1. Installation of new watering points opened up new areas for grazing which were utilised by cattle and allowed areas that had been continuously grazed to be rested.
2. The increase in activity at or close to watering points was documented.
3. Data and observations show the sacrifice zone around new watering points to be much smaller than sacrifice zones around continuously grazed watering points.
Perennial grass tussocks were still present as close as 50m from the trough after two grazing events.

The greatest contrast exists when comparing the observations from May 2004 with May 2006. The seasonal effects contribute to the amount of pasture present although the trends emerging are an encouraging sign as to the benefits of the alternate waters management.

4. Recovery of and increase in perennial grass species close to those watering points which were previously continuously grazed. Observations in 2006 indicated the presence of perennial pasture species (Mitchell grass) within 50m of the watering points, and as close as 50m in areas, where the species was not present before.

The increase in perennial grass species within traditional sacrifice zones represents an improvement in pasture composition. Increases in perennial grasses offer more feed towards the end of the dry season increasing the overall carrying capacity of the paddock.

Cattle Performance

5. All cattle went into the treatment and control paddocks preg-tested in calf. The re-conception rate of the treatment cattle was significantly lower than the control cattle. This may have been a result of the treatment, compounded by a long dry season in 2004. Poor performance occurred during the first and second years of the trial and has been attributed to the change in behavioural patterns.
Manager observed that cattle were hardly impacting on the volume of feed near the new watering points. Number of cattle in treatment mob was increased to make more efficient use of pasture. So although individual performance was not increased during the early years of the trial, the overall kg/ha had increased in 2006 due to the increase in number of cattle that the treatment paddock could run.

7. Moving cattle more frequently (between two of the new watering points) was also tried during early 2006 to make use of the late wet and abundant soil moisture which promoted second phase of new growth of Mitchell grass.

8. Manager observed changes in the herd dynamics of cattle in the treatment paddock. In 2006 the treatment cattle were observed to stay together as a mob. Previously the cattle has been scattered in small groups across a large area, which is still seen in the control paddock. “Bulls are with cows all the time, not hanging by themselves, (would expect this to have positive impact on calving rate) and cattle are not as spread out when grazing, but moving more as one mob.” B. Wratten, Manager.

6. There was no significant difference between the average weight of cows from treatment or control paddocks (refer to Table 1). There was also no significant difference between the average weight of the weaners turned off from the treatment or control paddocks (refer to Table 1).

Graph 3: No. 12 watering point represents an existing water that was traditionally managed under a continuous grazing regime. The watering point is now managed under the alternate watering management and appears to be responding to the periods of plant rest that have been introduced. The increase in pasture between 50m and 1500m is significant and represents a vast improvement in the amount of feed available close to the watering point. The steep increase of the yellow line between 50m and 250m is consistent with other grazing trials where spelling has been introduced. This is in direct contrast to the blue line which represents the available pasture under the continuous grazing regime. There is also a significant increase in the amount of pasture present between 1750m and 4000m with increases of approximately 1800kg/ha at 3500m.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trial No 12</td>
<td>Control No 8</td>
<td>Trial No 12</td>
</tr>
<tr>
<td>number of cows</td>
<td>832</td>
<td>811</td>
<td>906</td>
</tr>
<tr>
<td>average weight cow</td>
<td>375.31</td>
<td>374.88</td>
<td>465</td>
</tr>
<tr>
<td>av preg test result (months)</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>number of calves</td>
<td>510</td>
<td>298</td>
<td>56</td>
</tr>
<tr>
<td>calving per cent</td>
<td>588</td>
<td>494</td>
<td>165</td>
</tr>
<tr>
<td>number of weaners</td>
<td>179</td>
<td>222</td>
<td></td>
</tr>
<tr>
<td>average weight weaner</td>
<td>179</td>
<td>222</td>
<td></td>
</tr>
</tbody>
</table>
Impact on Station Management

9. Holding the cattle on watering points proved difficult during 2004 but was resolved in 2005 through the persistence of the manager. Problems were experienced in the first year of the new management system when trying to move the cattle from one watering point to the next. Cattle continually wanted to return to their home grounds, so staff had to stay with the cattle to hold them on the new watering point. A procedure was established whereby the watering point that the cattle were on was turned off the day prior to moving. This became the ‘cue’ into training the cattle to move. The persistence of the manager resulted in the cattle becoming easier to move and by the end of 2005 this task was able to be completed by an individual in a single 4WD or motorbike.

10. The problems experienced in the first year of the trial meant that the whole stock camp was required when moving cattle from one watering point to the next and to hold cattle on the new watering point. The high levels of labour required impacted on station operation, making it difficult to manage without employing extra staff. Training the cattle to move on cue solved this problem.

It has been necessary for staff to check the treatment paddock each day to check the location of cattle and the water supply. Under continuous grazing practices the paddock would only be checked every few days. It was necessary to check paddock for strayed cattle for several days after moving them, and this was time consuming and took staff away from other activities. The station stock camp did not have enough people to cover this, so it would have been beneficial to have an extra staff member employed to assist with looking after cattle in the treatment paddock.

11. Problems were also encountered in relation to water storage. The tanks used to store water at the new watering points could not always keep up with demand and did not provide a safe amount of storage in case of problems with the bore or trough. If there was a problem with the water supply then management only had a day to find the problem and fix it before the water ran out. Hence the need to check the waters every day.

12. Manager has learned to use the rotational system to its best potential by controlling where cattle are grazing and having cattle closer to the yards at mustering time, reducing the need for helicopter use. This has lead to savings in time and money when mustering the treatment paddock.

Conclusion

Preliminary results and observations from the trial indicate that managing cattle by alternating watering points is possible within the extensive grazing systems of the Barkly Region.

Greater influence over the areas of the paddock that are grazed has been achieved through investing time in training cattle and modifying their behaviour. This investigation has been able to demonstrate that perennial grass species increased through the period of rest introduced by the alternate waters management system. Individual performance of cattle was not increased during the early years of the trial, but the overall kg/ha was increased by being able to run more cows due to more efficient use of the paddock.

The ability to manage the cattle alternating watering points represents a vast change from traditional grazing strategies and is considered a major achievement of the investigation. Continuation of the trial will allow us to obtain more results to see the impact on cattle performance and pasture condition over the long term.
What is the optimal level of pasture utilisation by cattle in the VRD?

Robyn Cowley, Kieren McCosker and Neil MacDonald, NT Department of Primary Industry, Fisheries and Mines. Phone 8973 9739.

Summary
Twenty per cent utilisation is the optimal level for land condition, diversity and individual animal production. Utilisation levels above this did achieve higher per unit area production on average, but animal production was much more variable through time and land condition and biodiversity declined.

Introduction
Utilisation is the proportion of the pasture that grows each year that is consumed by cattle.

Methods

Mt Sanford – Research Scale
Utilisation 2001-2006
Paddocks were stocked for six years at six utilisation rates ranging between 12 and 43 per cent at the research scale (4-12 km²) on Mt Sanford.

Paddocks have been stocked for five years at five utilisation rates ranging between 15 and 44 per cent in commercial scale paddocks (20-22 km²) on Pigeon Hole. This trial finishes in October 2007.

At both sites animal numbers were adjusted each May according to the amount of pasture available to achieve the target utilisation rate for the paddock (Table 1).

Table 1: Treatment stocking rates and utilisations

<table>
<thead>
<tr>
<th>Mt Sanford</th>
<th>Pigeon Hole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Utilisation rate (%)</td>
<td>Average stocking rate (AE / km²)</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>19</td>
<td>17</td>
</tr>
<tr>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>28</td>
<td>22</td>
</tr>
<tr>
<td>36</td>
<td>27</td>
</tr>
<tr>
<td>43</td>
<td>38</td>
</tr>
</tbody>
</table>
Results and Discussion

Mt Sanford – Research Scale
Utilisation 2001-2006

Land condition and biodiversity
Above 21 per cent
• Bare ground levels in October were unsustainable (greater than 60 per cent) (Figure 1)
• Bird abundance declined
• Some palatable plant species declined

Animal production
Above 21 per cent utilisation:
• Individual weight gain was reduced by 10 kg
• Breeders took 1.5 months longer to re-conceive
• Weaning rate was nearly 10 per cent lower

Animal production per area was highest at highest utilisation rates on average, but it was much more variable through time, as animals took longer to get over dry periods at higher utilisations (Figure 2).

Figure 1: Effect of utilisation on per cent bare ground in October at Mt Sanford 2001-2006. Values above 60 per cent bare ground are above the red line, and occur at utilisation rates 28-43 per cent from 2003 to 2005.

Figure 2: Weaner production per unit area through time at Mt Sanford.
Unlike the Mt Sanford trial, there were large fires at the Pigeon Hole site during the trial. These occurred in different paddocks at different times. The effect of fires on vegetation, and hence animal production (through removal of poor quality dry forage) often overrides other treatment and sometimes seasonal effects.

There was no effect of utilisation on land condition through time at the commercial scale.

Initially there was little effect of utilisation rate on weight gains, partly because of the overriding effect of fire in some paddocks. However since 2006 (less fire influenced and more time for treatments to take effect) there has been consistently higher weight gains in the lower utilisation paddocks (Figure 3). This effect was greatest during the wet season.

The effect of utilisation on branding percentage varied through time. In 2004 branding percentage was highest at lower utilisations. This pattern disappears in 2005 and 2006, after fires in some of the paddocks in 2005 start to have a greater effect on animal production. At high utilisation rates there are large fluctuations in branding percentage through time. (Figure 4).
Conclusions

Large paddocks may already have average utilisation rates at around 20 per cent but where waters are sparsely distributed, actual utilisation around waters is likely to be much higher, but very low beyond three km from water (see Leigh Hunt’s paper recommending maximum distance to water of 2.5km for even grazing distribution). By adding waters to large sparely watered paddocks, actual utilisation may decrease, by making utilisation more even across the landscape and can provide significant animal production gains.

Future research

The regional implications of the trial recommendations are being investigated by DPIFM. This includes the potential for future development in the northern NT and how this may effect infrastructure, staffing, cattle turnover and the NT economy.

Recommendations

20 per cent utilisation is the magic number!

For red soil this may be lower. DPIFM currently recommends 15 per cent utilisation for red soils, as these land types are less resilient.

Producers looking for development opportunities should analyse current utilisation rates to identify potential gains in animal production and land condition from infrastructure development.

The MLA Grazing Land Management course (run by NT DPIFM) can assist producers to identify their current utilisation rates and plan property development and management strategies to provide sustainable improvements in animal production and land condition.

Further reading

North Australia Beef Research Council.

Introduction

The term ‘biodiversity’ is shorthand for the ‘variety of life’. It includes all the different species of native plants and animals, the variety of environments in which they live, and the natural processes that sustain them. Biodiversity is an important part of the overall ‘health’ of a landscape – it contributes to ecosystem function and to the resilience of the system (the ability to recover from undesirable change).

Pastoral lands are very important for biodiversity conservation in the tropical rangelands of northern Australia. Many species and their habitats occur only on pastoral lands, or rely on these areas for their survival. Where pastoral landuse maintains native pastures and avoids broadscale clearing, it is also possible to maintain good quality habitat for many native species. Unfortunately, we also know that overgrazing or other poor management can lead to negative impacts on biodiversity, and ultimately the extinction of some species. As new grazing management systems are developed in the tropical rangelands, it is important to ensure that they do not reduce regional biodiversity values.

In extensive grazing systems like that in the VRD, pastoralists are seeking to improve economic performance and achieve more uniform grazing. While this may have some positive environmental benefits, it could also have negative impacts on certain native species. Research has shown that in most environments there are a set of species (known as decreasers) that are sensitive to grazing, and these species thrive in areas of land that receive little or no grazing (often areas that are a long way from watering points). If intensification of pastoral use means that most of the landscape is subject to relatively high utilisation levels, then some or many of these species will have no ‘refuges’, and may gradually disappear from that landscape.
Biodiversity studies in the Pigeon Hole Project

The biodiversity studies in the Pigeon Hole Project aimed to answer two main questions:

• Are there different impacts on biodiversity from the different utilisation levels and grazing management systems? In particular, is there a ‘threshold’ level of utilisation above which there is unacceptable negative effects on native plants and animals? Alternatively, were some of the grazing management systems ‘better’ for biodiversity than others?

• Assuming intensification of pastoral use has some negative impacts on biodiversity, are there management options to help protect the native wildlife that occurs within the property? For example, would setting aside some areas of the paddock help to protect the most grazing-sensitive species? How large would these areas need to be in order to be effective?

It is not possible to sample all of ‘biodiversity’. We chose to study plants, birds, reptiles, small mammals and ants, as representatives of biodiversity in the trial area. We wanted to understand if the total number of species and the species composition (what particular species occur there and the relative abundance of each) changed over time depending on the management system or utilisation level.

We set up a large number of sample sites in most of the different grazing management treatments within the Pigeon Hole Project (see map) and monitored biodiversity at these sites for each year that the project was running. We also set up a total of 16 exclosures of different sizes (0.4ha to 400ha) where there was no grazing, and monitored what happened to the biodiversity in these ‘conservation areas’. There were a total of 100 biodiversity monitoring sites, which were sampled twice each year from 2003 to 2007.

Biodiversity at Pigeon Hole

Our sampling showed the large number of native plant and animal species that occur within the project area (see Table). Within a single hectare, there could be as many as 85 plant, 26 ant, 25 bird, eight reptile and two...
small mammal (as well as two macropod) species. It is worth noting that the cracking-clay grasslands within the Pigeon Hole Project are one of the more species-poor habitats in northern Australia, and the number of native species occurring in most woodland areas would be considerably higher.

<table>
<thead>
<tr>
<th>Total number of species (all sites)</th>
<th>Average number of species per ha.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants 231</td>
<td>39.0</td>
</tr>
<tr>
<td>Ants 63</td>
<td>20.2</td>
</tr>
<tr>
<td>Birds 75</td>
<td>9.2</td>
</tr>
<tr>
<td>Small mammals 4</td>
<td>0.5</td>
</tr>
<tr>
<td>Reptiles 20</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Sampling over five years showed that there was a lot of variation in species richness and composition at our sites over time, not related to the grazing treatments. For example, the average number of bird species per site in 2005 was about 50 per cent higher than other years, whilst the mean number of plant species per site was lowest in that year. These differences between years were mostly due to variation in the amount and timing of seasonal rainfall at Pigeon Hole, although changes in bird composition also depended on conditions in other parts of the region or country (for example, there were huge numbers of budgerigars in 2005, but few in other years).

Although the Pigeon Hole project area is relatively uniform in habitat, there was also quite a lot of variation in species composition between sites across this area (which may partly be related to the previous, long-term grazing history). These sources of variation are important to understand, because they make it more difficult to detect any changes in biodiversity due to the new grazing treatments.

Effects of grazing management treatments on biodiversity

Some biodiversity data is still to be collected in late 2007, and analysis of all the biodiversity data has not yet been completed. Preliminary analyses show that none of the different utilisation levels, or grazing management systems, caused pronounced changes in biodiversity over the first four years of the trial. Rather, the new grazing regimes have tended to make species composition more similar amongst biodiversity sampling sites, reducing the pre-existing differences between treatment paddocks. There was some indication from the 2006 data that bird composition within exclosures was diverging from that of sites in adjacent grazed paddocks, and (as would be expected) the cover and basal area of perennial grasses has gradually increased in the exclosures.

Conclusions and management recommendations

Biodiversity sampling in the Pigeon Hole Project has shown that there were not significant short-term impacts on biodiversity from relatively high levels of utilisation, or from a variety of grazing management systems. However, the implications of these findings for pastoral development in the broader region must be considered cautiously:

- As noted above, natural variation in this system makes detecting management-related changes difficult, until these are quite pronounced;
- It is likely that the effects on biodiversity of a new grazing management regime will only become evident in the medium- to long-term (particularly after several cycles of good and poor seasons). For this reason, we recommend that there must be adequate long-term monitoring of biodiversity in tropical rangelands;
- A number of studies have shown that these black-soil grassland systems are relatively resilient to grazing impacts. It is likely that the impacts on biodiversity would be more rapid and pronounced should similarly high utilisation levels be applied in most other land types.
Management recommendations aimed at protecting biodiversity will be refined at the end of this project. However, information from a number of studies has been used to develop a set of general guidelines for biodiversity-friendly land management in the tropical rangelands¹, and these are summarised below.


Further information
There is a large amount of information available about biodiversity in the northern Australian rangelands, and how grazing (and other land management issues) affect biodiversity. Most of this information is accessible through the ‘Northern Australian Land Manager’ website being developed by the Tropical Savannas CRC (www.landmanager.org.au).

Management guidelines for retention of biodiversity in tropical savanna rangelands

These guidelines are primarily aimed at management at an enterprise scale, and complement biodiversity management actions at regional (as defined in regional Natural Resource Management Plans) and State scales (eg. NT Parks and Conservation Masterplan).

1. Maintain cover and diversity of native perennial grasses
   - this will help guarantee the survival of many native plant and animal species
   - this is already a goal of good pastoral management, and ways to achieve it are described in Grazing Land Management manuals (noting that the use of exotic species is counter-productive)
   - management strategies may include conservative and/or variable stocking rates, wet-season spelling, rotational grazing, and the maintenance of appropriate fire regimes.

2. Where possible, use grazing strategies that rest large areas of country
   - this will assist in the seeding and recruitment of native plant species, improve breeding success in some native animals, and reduce predation on some species
   - may be achieved by wet-season spelling or rotational grazing systems
   - particularly important where there are high stocking rates.

3. Protect special areas, by fencing out stock if necessary
   - special areas include key habitat for threatened species; important breeding areas for animals (such as waterbirds); vegetation types that are very sensitive to grazing; and remote or unwatered country (see below).

4. Where possible, retain and protect natural waterholes
   - waterholes and creeklines are usually rich in plant and animal species; contain species that are not found elsewhere in the region; and often have special species or breeding areas
   - these areas are also vulnerable to damage by concentration of stock
   - where possible, fence off waterholes and major creeklines and pipe water outside the fences (although not into previously ungrazed areas).
5. Retain some areas on the property (of each habitat) with little or no grazing pressure
   - this will help maintain populations of all species on the property, particularly the ones most sensitive to grazing
   - ideally, the non-grazed areas would be 5-10 per cent of the area of each land type on the property
   - ideally, these areas would be in a few large blocks rather than tiny, scattered areas
   - having little or no grazing pressure may be achieved by controlling the spread of waterpoints and/or by fencing ‘refuge areas’
   - this principle becomes more important as pastoral use is intensified.

6. Try to maintain a variety of burning regimes
   - different plant and animal species require different fire regimes – so a variety of burning practices will benefit most species
   - avoid either no fire, or very frequent fire, over large areas of country
   - avoid burning large areas of country in most years
   - a patchy pattern of burning is ideal, with some areas that are not burnt for a long time. This can be achieved through cool winter burns, or storm burning
   - the period areas are best left unburnt will vary from region to region, and local information should be sought as to appropriate periods.

7. Maintain structural and micro-habitat diversity
   - leaf litter, fallen logs, standing dead trees, large trees with hollows and termite mounds are all important habitat for some species
   - a diverse midstorey with trees and shrubs of a variety of ages and sizes contributes to habitat diversity
   - avoid grazing and fire regimes that reduce this diversity over substantial areas.

8. Control problem weeds and restrict further spread
   - this is a standard management practice on most properties
   - identify and target weed species that threaten special areas or special species (eg. taking over areas used by breeding waterbirds)
   - exotic pasture species can be considered as weeds to native wildlife. Ideally all introduced species should be avoided, but if exotic pastures occur, prevent these species becoming dominant over large areas.

9. Control feral grazing animals
   - this is a standard management practice on most properties, and reduces total grazing pressure
   - concentrations of feral animals may damage special habitats, even in areas set aside for conservation.

10. If possible, reduce numbers of feral predators
    - cats (and in some areas, foxes) kill large numbers of native animals, but are very difficult to control
    - dingos may help keep cat and fox numbers down. Dingos can also help control feral pig numbers (which damage wetlands and riparian areas), and reduce the numbers of large macropods (which contribute to total grazing pressure).
11. If possible, avoid clearing native vegetation
   - clearing, especially over large areas, dramatically effects many native plants and animals
   - if clearing is considered essential, restrict clearing to <30 per cent of each land type (habitat) on each property, and create mosaics of cleared and uncleared vegetation, rather than extensive clearings.
   - retain substantial buffers of native vegetation around watercourses and wetlands, and retain connecting strips of native vegetation within cleared areas
   - the trade-off for clearing should be lower stocking rates and/or improved spelling in other parts of the property
   - in certain cases, it may be important to control the invasion of native grasslands by woody plants, or ecologically undesirable thickening of tree or shrub layer, through appropriate fire management.

12. If possible, avoid using introduced pasture plants
   - where introduced pastures are considered essential, make sure introduced species can’t spread outside a controlled area
   - prevent exotic pastures from becoming dominant monocultures, as this can reduce wildlife diversity, and eliminate palatable native grasses
   - restrict introduced pastures to a small, concentrated portion of the property (such as those that are already cleared or in poor condition)
   - the trade-off for introduced pastures should be lower stocking rates in other parts of the property.

13. Be informed about biodiversity
   - find out what habitats and species occur on your property
   - try and observe annual and seasonal patterns of wildlife on your property
   - find out where the special places and special species occur, and what special management they might require
   - seek expert advice or assistance if necessary.

14. Be aware of changes in biodiversity
   - are some species declining or disappearing?
   - are some species getting more common?
   - are new feral (pest) species appearing?
   - these changes may indicate management issues that need to be addressed
   - if possible, keep a record of your biodiversity observations.

15. Have a property management plan that considers biodiversity
   - the plan would address all the issues listed above
   - the biodiversity management section would integrate with the property grazing land management systems
   - the property plan should be developed in the context of regional biodiversity values, neighbouring and regional landuse patterns, and regional and State NRM or conservation plans
   - seek expert advice or assistance if necessary.
The project aimed to investigate the possibility of using a telemetry solution to reduce the need for bore visits, and therefore reduce station operating costs.

As northern cattle stations develop additional waters and infrastructure within their business, the cost of managing and monitoring the bores is significantly increasing. On a ‘typical’ station a boreman will check every stock water point two to three times a week to ensure cattle have sufficient water. This requires the boreman to drive 50+ hours a week over rough station tracks, in many cases to just confirm there are no problems at the water points. Fuel prices, vehicle costs, and labour costs and availability have all continued to move against the producer, all of which are significant inputs to bore running costs.

During the project there has been the successive development and refinement of telemetry solutions that will potentially cut the boreman’s work load by at least 50 per cent.

The development has been primarily undertaken in conjunction with Observant Pty Ltd.

Objectives
The project objective was to evaluate the ability of remote monitoring solution on a large pastoral property to reduce the number of physical visits, and therefore bore running costs.

To be the remote ‘eyes and ears’ of the boreman, a range of sensors (water flow, water level, rainfall) and a range of equipment (medicators, engine controllers) would need to be connected to small, robust, solar powered computers connected by UHF radio back to a central location. The system needed to:

- monitor the level of water in the turkey nest or trough
- monitor and control bore pumps
- monitor and log information from water medicators
- monitor and log information from raingauges spread around the station
- gather still photo images of cattle watering at the trough for ultimate peace of mind.

In addition, the eventual goal was to have the system be able to automatically start and stop bores based upon the depth of water in a given nest.

Challenges
When the project started, we were frustrated to find that although there was great awareness of the promise of telemetry, there were no commercially available telemetry systems that met the specific needs of the northern pastoral industry. Existing systems were either too limited in capability, or too expensive for the industry.

Key Supplier: Observant Pty Ltd
For that reason, the project elected to contract a private company (now Observant Pty Ltd) to provide an early release of their system that had been under development for several years. Although there was some risk in choosing a partially developed and unproven system, and of course additional lead time, the advantage of having strong input into the development direction of the product was deemed very important.
Other Suppliers
Some of the infrastructure, such as water medicators and engine control systems, were reasonably sophisticated, but did not have any interface capabilities. Considerable effort has been spent on getting vendors talking to ensure that their machines can work together into a single monitoring system.

Robustness
Many challenges were encountered with the early prototypes: physical and electrical robustness, software issues, weatherproofing and vermin-proofing. With each wet season we learnt more about how to protect the system from the elements, and with each delivered generation of the system, project staff were able to feed software and other product requirements and suggestions back to Observant.

For the first three years of the project the system was very much still under active development, but through 2006 the vast majority of the issues were sorted out and the system has been put in to active use over the last year.

Remote Diagnostics
Diagnosis of faults in the telemetry system could often prove difficult. Station staff are not always able to determine the nature of the fault and the equipment is often situated remotely, making physical visits time consuming, expensive, and during the wet season, often not possible.

Observant recognised early on that thorough remote diagnostics were vitally important in order to provide a practical product. Considerable effort has gone into the system such that any internal problems and system health parameters can all be read remotely, and that software updates can be deployed over the radio without any station intervention.

Outcomes
The project has heavily influenced and catalysed the development of a rapidly maturing and nationally recognised market for the supply of pastoral telemetry systems.

When the project commenced there were few viable for the pastoral industry. Today there is significant focus on the provision of products and services in this area and technology producers and customers are engaged in an active dialog that is providing real solutions.

The inclusion of telemetry in the Pigeon Hole project has also directly contributed to the commencement of further trials of telemetry and in particular of the direct financial benefit of using commercially available solutions.
Specific project outcomes include:

- A system which is able to remotely monitor and control a wide range of equipment traditionally deployed on station to aid in the production activities of northern pastoral producers:
  - Water tank, nest and trough levels (accurate to less than 2cm)
  - Full automatic monitoring, protection and control of diesel, solar and electric pumping equipment
  - Rainfall and water flow measurement with up to one second resolution
- Deployment of the system on to 21 water points situated throughout the trial site
- The development of a comprehensive log of rainfall, water and nutrient usage across many trial sites for large parts of the latter part of the project. This data has also been used to support other research conducted by Damien Effeney as directed by Dennis Poppi¹

- Development of sophisticated remote error diagnosis tools to significantly aid in troubleshooting problems without needing to physically visit equipment.
- Delivery of a viable, still image camera solution that works on solar power and UHF radio; this was previously thought to be technically infeasible.

¹ “Measurements of Water Intake by Cattle Using Telemetry in the Victoria River District, Northern Territory, Damien Effeney, School of Land and Food Sciences, The University of Queensland”
Along with the introduction of the National Livestock Identification System (NLIS) comes a good opportunity to assist producers to increase their herd efficiency and profitability whilst maintaining country in good condition. In addition to tracing the movements of cattle, the NLIS provides a good base for the collection and analysis of herd performance information aimed at improving management decision making.

Using individual animal identification and a system for recording and retrieving information related to those animals, producers can more confidently eliminate the passengers in the herd and also select for those cattle that are performing well in the conditions on your property. With ever increasing costs and decreasing margins it is essential that country is grazed as efficiently as possible to provide the best returns. We want to be grazing the cattle that are most productive and profitable for us and be able to do this whilst maintaining country in good condition into the future.

Known as the “Applied Pastoral Information Technology Project” this work is being led by the NT Cattlemen’s Association with funding from the AG NLP NRIG funding stream and is being delivered by Consolidated Pastoral Company and MB Consulting.

The project aims to:
• develop and demonstrate systems for improved information management on extensive cattle properties.

Improving Herd Efficiency and Profitability Whilst Maintaining Good Land Condition

Key outputs of the project will be:
• measured performance and details of a Best Practice Heifer management system.
• measured performance and details of a Best Practice Breeder management system.
• details of how the info collection system works and how info is incorporated into management decision making.
• details of the staff and system requirements needed.
• details of infrastructure required and systems for data management.
• demonstration of risk management strategies – what to do when it all goes pear shaped.
• management reports and how to integrate them into decision-making.

Progress to date:
• The project is being run on Auvergne Station between Timber Creek in the NT and Kununurra in WA.
• The focus is on four large paddocks on different types of country and stocked with different age groups of cattle.
• The planned modifications to cattle yards have been completed and systems for recording and analysis of data have been put in place.
• The first round of mustering is now complete and details of how the technology went as well as the cattle performance and land condition assessments will be available soon.
# Pigeon Hole Field Day

**Grazing Strategies for Tomorrow**

**Program**

### 8th August

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>9:00am</td>
<td>Field day start, morning tea</td>
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<tr>
<td>9:30am</td>
<td>Welcome (DPIFM Minister Chris Natt and MLA Manager Northern Production Research, Wayne Hall)</td>
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<tr>
<td>9:40am</td>
<td>Introduction - Steve Petty - economics and wider industry implications of different grazing systems trialled at Pigeon Hole</td>
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<tr>
<td>10:00am sharp</td>
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<tr>
<td>11:00am</td>
<td><strong>STOP 1</strong> Bullock Paddock – Grazing systems</td>
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<tr>
<td>11am</td>
<td>Lindy Symes - practical management tips and animal production outcomes from the wet season spelling and cell grazing systems</td>
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<tr>
<td>11:20am</td>
<td>Andrew White – Perennial grass responses to various simulated wet season spelling treatments</td>
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<tr>
<td>11:30am</td>
<td>Pippa Krafft – Newcastle Waters Rotational Grazing</td>
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<td>11:40am</td>
<td>Animal distribution</td>
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<tr>
<td>11:40am</td>
<td>Leigh Hunt – Options for managing grazing distribution</td>
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<tr>
<td>12:00pm</td>
<td>Suzie Kearins – Rockhampton Downs Rotational Water</td>
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<tr>
<td>12:45pm</td>
<td><strong>STOP 2</strong> Dead Cat Paddock – Lunch (12.45-1.15) on creek</td>
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<tr>
<td>1:20pm</td>
<td>Kieren McCosker – Optimal Utilisation rates for Animal Production at Mt Sanford</td>
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<tr>
<td>1:30pm</td>
<td>Robyn Cowley – Optimal Utilisation rates for maintaining land condition at Mt Sanford and Pigeon Hole.</td>
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<tr>
<td>1:50pm</td>
<td>drive by trough to see animals</td>
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<tr>
<td>2:30pm</td>
<td><strong>STOP 3</strong> Brolga Paddock – Maintaining biodiversity</td>
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<tr>
<td>2:30pm</td>
<td>Alaric Fisher – Maintaining biodiversity as properties develop</td>
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<tr>
<td>4:00pm</td>
<td><strong>STOP 4</strong> No. 12 Bore – New Technology and Improved Management techniques for development</td>
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<tr>
<td>4:00pm</td>
<td>Steve Petty - improved management techniques for developed properties: cost of mustering and fencing, design of site</td>
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<td>4:10pm</td>
<td>Water medication – Tony Wood</td>
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<tr>
<td>4:20pm</td>
<td>Simon Holmes a Court – Telemetry systems demonstration</td>
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<tr>
<td>4:50pm</td>
<td>Steve Petty – Concluding comments / best bet principles. How to intensively develop and manage a site – facilitated discussion</td>
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<tr>
<td>6:00pm</td>
<td>Matt Bolam – Using NLIS data to better manage cattle and country</td>
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<tr>
<td>7:00pm</td>
<td>Dinner</td>
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### 9th August

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>7:00am</td>
<td>Breakfast for people who stayed overnight</td>
</tr>
<tr>
<td>9:00am</td>
<td>Everyone departed</td>
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</tbody>
</table>

**Thanks to our refreshment sponsors**

- Elders
- The Hootchery