Cattle and land management best practices in the Top End region 2011
Monza Recycled contains 55% recycled fibre (25% post consumer and 30% pre consumer) and 45% elemental chlorine free pulp. All virgin pulp is derived from well-managed forests and controlled sources. It is manufactured by an ISO 14001 certified mill.
The idea for this Top End Best Practice manual came from the request by Top End producers, particularly, those with areas of coastal floodplains on their properties, for written information on the management of cattle on the floodplains. This was expanded to include all Top End properties, as some of the specific information provided for upland properties in the Katherine Best Practice manual is not relevant for Top End producers.

The intensification of management on most properties, including the sowing of larger areas of improved pastures has seen a need for revised management practices such as rotational grazing, more weed control and prevention of burning.

This manual has endeavoured to find a balance between practical producer knowledge and experience and sound scientific advice. Reference resources are provided if readers require more detail on a particular subject.

This manual needs to be a living document to enable producers to keep abreast with developments and new methods and techniques which may become the new Best Practice. It is planned to periodically update this manual in an endeavour to reflect progress and include new technology.

I recommend this manual as a good starting point for all producers and particularly those new to the Top End of the Northern Territory.

Cheers,

Tony Searle
Manager
Melaleuca Station

Former Chairman
Top End Branch
Northern Territory Cattlemen’s Association
The Landforms

Floodplains

Upland

Hills
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Acknowledgements

This publication was compiled and edited by Arthur Cameron, Department of Resources (DoR), with assistance from the other two members of the Steering committee, Phil Hausler, DoR and Tony Searle, Manager of Melaleuca Station.

This publication would not have been possible without the generous assistance, persistence and patience from the following:

- Meat and Livestock Australia for their funding support.
- Staff contributors from the Northern Territory Government Department of Resources, particularly the Katherine based staff who contributed to and produced the Katherine Best Practice manual, Jessica Mayes, formerly DPIFM, Trudi Oxley, Neil MacDonald and Renee Golding.
- The other Authors.
- Top End cattle producers, particularly those with floodplain properties who volunteered their time and knowledge.
- Staff from the Northern Territory Government, DoR, Executive and Communications Services group.
- Staff from the Northern Territory Government, DoR, Primary Industry Publications Section.
- Staff of Meat and Livestock Australia for the final edit of the document, particularly Geoff Neithe, Michael Quirk and Rodd Dyer.

We would like to thank the producers of the Top End Region for their support in collaborating with research and extension projects over the years. Through generously adding their experience we collectively hold a large body of knowledge about how to sustainably and productively manage a beef cattle enterprise in the region.

In particular, we gratefully acknowledge the diligence and tolerance of many contributors who are not DoR staff, busy people, and experts in their field who have significantly enhanced the knowledge of the department.
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<td>ABL</td>
<td>Australian Bat Lyssavirus</td>
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<tr>
<td>AE</td>
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<td>AFIA</td>
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<td>Australian Standard for Export of Livestock</td>
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<td>Bull Breeding Soundness Evaluation</td>
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<td>Body Condition Score</td>
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<td>Description</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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<td>Intramuscular Fat</td>
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<td>LEAP</td>
<td>Livestock Export Accreditation Scheme</td>
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<td>Northern Territory Agricultural Association</td>
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<td>NVD</td>
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<td>Polymerase Chain Reaction</td>
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<td>PIC</td>
<td>Property Identification Code</td>
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<td>Rumen Degradable Nitrogen</td>
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<td>RWDMG</td>
<td>Regional Wild Dog Management Group</td>
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<td>WA DPI</td>
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<tr>
<td>WDOT</td>
<td>Willis Dropped Ovary Technique</td>
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<td>WHP</td>
<td>Withholding Period</td>
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<tr>
<td>VRD</td>
<td>Victoria River District</td>
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<td>Victoria River Research Station</td>
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Introduction

The Top End or Darwin region is a small but diverse area of the Northern Territory producing feeder cattle predominantly for the live export market in South-East Asia. Production is based on improved and native pastures. The industry is described in more detail in the Darwin Pastoral Industry Survey 2004, available from DPI&F, Publications Section in Darwin.

The region extends from Jindare Station near Pine Creek in the south to the coast in the North, and from Kakadu National Park in the East to the coast in the West (Figure 1).

This manual is intended to cater for producers who are new to the region and want to understand the basics of operating in the Top End environment and production systems, right through to the experienced long-term producers who want to update their knowledge.

Many publications referenced in this manual are available from the internet or bookstores. If you have any difficulty sourcing a reference you are interested in, please call the DPI&F Publications Section. This manual is available on the DPI&F website where it will be continually updated (www.nt.gov.au/d).

Climate and seasons

The Top End region has a semi-arid monsoonal climate with a reliable ‘wet season’ from October to April, and a virtually rainless ‘dry season’ from May to September. The wet season is reliable in that there is always a wet season to grow established pastures. There is considerable variation in when the wet season starts, when the rain falls during the wet season (rainfall distribution) and when the wet season finishes. The duration of the wet season can vary dramatically from year to year. More than ninety percent of the rainfall falls in the months from November to March.

The wet season generally begins with isolated storms in September. The storms increase in frequency during October and November. This period, known as the “build up” is characterised by high temperatures and high humidity. It is an extremely uncomfortable time for people and animals. Periods of widespread monsoonal rain which can occur during late December occur more frequently in the January-March period. During monsoonal periods conditions are generally cool and wet. It can be overcast, cool and rain every day for weeks on end. It is not unusual to experience a 2 to 3 week dry spell during January. February and March are most consistently the wettest months. After March, rainfall again comes from increasingly less frequent storms, and conditions are again hot and humid.

Rainfall intensity is often high during large thunderstorms, or during cyclones which threaten the Top End most years, and frequently cross the coastline.

Cyclones, while they are destructive, mostly directly affect the coastal areas of the Top End. During the wet season when cyclones occur, cattle are generally not affected as they are not present on the floodplains at that time of year. The indirect effect of cyclones is the severe flooding from the heavy rain associated with them. This severe flooding is often widespread, restricting access and movement across the Top End.

The dry season generally lasts from May to September, with virtually no rain falling in the months of June, July and August.

Average rainfall decreases with distance from Darwin on the north-western coastline. Rainfall averages 1917 mm in Darwin but drops to 1428 in Pine Creek and to 1220 mm at Douglas Daly Research Farm near the Daly River in the West.
Figure 1. Map of the Northern Territory showing the Top End region
Introduction

Size
The Top End region can be divided into the following districts based on river catchments: Adelaide River, Darwin and Rural, Douglas-Daly and Mary River.

Twenty five producers manage 20,680 km² of the Top End region predominantly as beef cattle enterprises.

Soils and vegetation

Adelaide River District
The Adelaide River basin immediately to the east of the Darwin District has two main land types, broad floodplains and low gravelly ridges. The soils of the lower Adelaide River floodplain are fertile deep cracking black clays. These floodplains do not have many trees. The native vegetation consists of sedges, rushes (Eleocharis sp.) and a range of grasses including Paspalum spp, annual Wild rice and Pseudoraphis spinescens with Hymenachne acutigluma on the deeper areas and channels.

The soils of the upper Adelaide River floodplains (Marrakai area) are mostly shallow infertile solodic and soloth soils. There are scattered shrubs and trees on these floodplains, Melaleuca and Eucalyptus. The understorey vegetation is predominantly Eriachne burkittii and Kangaroo grass (Themeda triandra).

The upland ridge country is predominantly infertile lithosol soils on the ridge tops with infertile yellow and red earths on the slopes. The native vegetation is open Eucalyptus savannah woodland with a component of Ironwood and an understorey of Acacias and Calytrix spp. The ridge tops are dominated by annual sorghum, while the slopes have a higher component of perennial grasses including Perennial sorghum, Kangaroo grass, Chrysopogon spp and Eriachne spp.

There are areas of deep levee soils along the middle stretches of the Adelaide River which are suitable for cropping, horticultural enterprises or improved pastures.

Darwin and Rural District
This district surrounding Darwin is characterised by flat or undulating terrain of ridges dissected by the Blackmore, Darwin, Elizabeth, and Finniss Rivers, and creeks.

The upland ridge country is predominantly infertile lithosol soils with infertile yellow and red earths on the slopes. The native vegetation is open Eucalyptus savannah woodland with a component of Ironwood and an understorey of Acacias and Calytrix spp. The ridge tops are dominated by annual sorghum, while the slopes have a higher component of perennial grasses including Perennial sorghum, Kangaroo grass, Chrysopogon spp and Eriachne spp.

There are scattered patches of good deep red earth soils which are suitable for cropping or horticultural enterprises.

There is some fertile cracking clay floodplain on the Finniss River, and there are areas of solodic soils along some of the creeks and drainage lines in the district, which are similar to those of the Adelaide River District.

Douglas–Daly District
The Douglas Daly District to the south-west of Darwin is mostly flat or undulating terrain with an area of rocky dissected hills in the southeast near Pine Creek and extensive floodplains near the mouth of the Daly River and on the Moyle River.

The soils of the lower Daly River floodplain are fertile deep cracking black clays. These floodplains have large patches of paperbark trees (Melaleucas) in some places. The native vegetation consists of sedges, rushes and a range of grasses including Paspalum spp, perennial Wild rice, Leersia hexandra, Phragmites karka and Pseudoraphis spinescens with Hymenachne acutigluma on deeper areas and channels.

The upland ridge country has a mixture of infertile lithosol soils with infertile yellow and red earths on the slopes. There are larger areas of the better Top End cropping and horticultural soils, Blain, Oolloo, and Tippera along the Daly and Douglas Rivers. There are areas of levee soils along the middle stretches of the Daly River which are suitable for cropping or horticultural enterprises.
The native vegetation is open Eucalyptus savannah woodland with a component of Ironwood and an understorey of Acacias and Calytrix spp. The ridge tops are dominated by annual sorghum, while the slopes have a higher component of perennial grasses including Perennial sorghum, Kangaroo grass, Chrysopogon spp, White grass (Sehima nervosum) and Bunch Spear grass (Heteropogon contortus).

Mary River District

The Mary River system east of Darwin and adjacent to Kakadu National Park is similar to the Adelaide River, with extensive fertile cracking clay floodplains on the lower reaches and infertile solodic floodplains on the upper reaches. The floodplains are surrounded by low gravelly ridges. The big difference between the two river systems is that the Mary River floods deeper and for longer each year.

The soils of the lower Mary River floodplain are fertile deep cracking black clays. These floodplains have large patches of paperbark trees in some places. The native vegetation consists of sedges, rushes and a range of grasses including Paspalum spp, annual Wild rice, Leersia hexandra and Pseudoraphis spinescens with Hymenachne acutigluma on deeper areas and channels.

The soils of the upper Mary River floodplains (Marrakai area) are mostly shallow infertile solodic and soloth soils. There are scattered shrubs and trees on these floodplains, Melaleuca and Eucalyptus. The vegetation is predominantly Eriachne burkittii and Kangaroo grass.

The upland ridge country is predominantly infertile lithosol soils on the ridge tops with infertile yellow and red earths on the slopes. The native vegetation is open Eucalyptus savannah woodland with a component of Ironwood and an understorey of Acacias and Calytrix spp. The ridge tops are dominated by annual sorghum, while the slopes have a higher component of perennial grasses including Perennial sorghum, Kangaroo grass, Cockatoo grass (Alloteropsis semialata), Heteropogon triticeus, Chrysopogon latifolius and Eriachne spp.

There are only small areas of soils suitable for cropping, with some of the deeper sandy soils being more suitable for tree crops and improved pastures.
Chapter One: Infrastructure and Station Development

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Careful construction and positioning of fences and roads will maximise efficiencies and reduce maintenance requirements. Roads and fence lines often serve as firebreaks and their location and maintenance can be critical in fire management and control. Clearing permits are not required for ‘linear infrastructure’ on stations.

Roads

Station roads are usually graded tracks, often along fence lines, necessary for access to watering points, lick stations, yards etc. The standard of road required will be determined by the class of vehicle expected to use it (road trains or light vehicles), the level of use and whether or not year-round access is required.

Location

The location of station roads on high ground, ridgelines and catchment boundaries will minimise erosion risk. Some soil types are more stable and less erodible than others. Wet season access will be improved by constructing roads on red soils or rocky or gravelly areas. Avoid black soils and grey/yellow earths where possible. Grey, yellow or pale termite mounds and tea tree stands are indicative of potentially boggy areas. Creek and river crossings will be most successful if located at right angles to the river, where river banks are lowest, where there is only one well-defined channel and on straight stretches.

Construction

Most station roads are constructed with a grader. The route may be cleared with a dozer. Forming of roads with a low crown along the centre will assist drainage and improve trafficability after rain, although crowning should be avoided in places where water needs to cross the road. Crowning may necessitate consideration of other erosion control works such as whoa boys or mitre drains. Where roads are unformed, avoid creating windrows which will concentrate water on the road and cause erosion and boggy sections. Windrows created by dry season grading can be spread back across the road prior to the next wet season. When grading, the direction in which soil is taken can be alternated, to prevent the construction of an ever-increasing windrow and gradual deepening of the road. Once a windrow has been left under a fence, it is very difficult to remove.

Gravelling or capping of sandy or boggy areas might be warranted. Small pipes under the road (such as 6” poly pipe) can assist drainage in trouble spots. Where the road or its verges are likely to concentrate water and erode, the construction of erosion control structures is recommended. Trafficability is important where banks are constructed across roads. Compaction and stability of the road and erosion control works will be greatest when there is some moisture in the soil during construction.

Maintenance

Annual post-wet season grading of roads is usually required to re-form the road, repair erosion control or drainage works and to remove vegetation. Sometimes erosion control works can be removed for the dry season or during times of high traffic and reinstated before the onset of the next wet season. Increasingly, chemical control of vegetation along roads is used to reduce grading requirements. Chemical application using quad bikes or from the air allows vegetation removal in wetter areas long before roads will carry heavy machinery. This can be important for fire control.
**Fences**

**Location**
Fences are located to achieve the best use of the country, taking into consideration pasture types, location of waters, river frontage protection, soil type, slopes, fire management and cattle management. Fence lines also serve as roads and firebreaks. The location of fences on ridgelines will reduce the risk of erosion and the need for erosion control measures. In the long term, maintenance costs will be less. Avoid locating fences and roads down long straight slopes or steep slopes, on unstable soils or near existing erosion.

**Construction**
Fences are most commonly constructed using steel posts and rails for end-assemblies, steel pickets and barbed wire, with droppers or spacers between pickets. A typical fence in the Darwin Region would have steel end-assemblies, star pickets spaced at 15 m, with one or two droppers between and three or four barbed wires. Wood is rarely used for posts anymore because of its susceptibility to fire and termites, and the ease of use and ready availability of steel. Ironwood (*Erythrophleum chlorostachys*) is the preferred species of wood. True to its name, ironwood is hard on tools and equipment.

For ease of construction and early protection against erosion, erosion control banks can be placed along the cleared and graded fence line prior to erection of the fence. The use of a residual herbicide might be considered to reduce regrowth of trees and shrubs on the fence line.

**Maintenance**
Traditionally, fence lines were graded with the objectives of providing a good road, an effective firebreak and protecting the fence from fire.

Herbicides are now being used in some places to keep fence lines clear, reducing the necessity to grade. This can have time, cost and soil conservation advantages. A herbicide such as Graslan®™ may be useful to control shrub and tree regrowth under the fence, out of reach of the grader.
Drainage and erosion control

In the long run, construction of erosion control works will be cheaper than repairing damage from erosion.

Erosion of roads and fence lines can result in:

• significantly higher maintenance costs
• increased travelling time
• increased vehicle maintenance costs
• reduced firebreak effectiveness
• reduced life and effectiveness of fences
• siltation of waterholes
• occupational health and safety hazards.

Erosion control on roads requires consideration of the likely amount of runoff expected, soil erodibility, slope and disposal or discharge of water. Effective and safe drainage is critical to erosion control. The three components of road drainage are surface, side and cross drainage.

Surface drainage

Crowning of roads allows drainage from the centre of the road towards sides. Crowns are only effective if the crown is higher than the adjacent land and should be avoided where water needs to cross the road. Water can be taken from the upslope side of a road to the downslope side by putting a slight crossfall on the road in the same direction as the slope. Alternatively, water can be intercepted on the upslope side with a drain and directed to a table drain, culvert or invert for the road crossing.

Side drainage

Table drains are excavated, flat-bottomed drains running parallel to the road. They direct water to disposal areas further downslope. Excavated material can be used for crowning. V-shaped drains are more likely to erode than flat-bottomed drains and are not recommended. Not many station roads will have table drains. Large table drains should be designed by an expert.

Mitre or off-shoot drains take water out of table drains or directly from the side of the road in the absence of a table drain. These drains direct water away from the road. They should also have a flat base and slope gently away from the road (0.5–1% slope depending on erodibility of the soil). Mitre drains must spill into stable, undisturbed areas, preferably from a level sill. The spacing of mitre drains depends on slope of the road or table drain, soil type and rainfall. Tables are available to calculate spacing. As an indication only, a road of slope 1% might require mitre drains spaced at least every 120 m. Drains must be long enough to ensure water does not end up back at the road.

Cross drainage

Cross drainage is required where water needs to be taken across the road from upslope table drains or drainage lines. Inverts and floodways are designed for water to flow over them while minimising erosion. Inverts may require the replacement of natural erodible material with rock or gravel. Floodways often use culverts or pipes to take base flows but are overtopped by larger flows. Protection of the downstream faces is critical to their success. Culverts are pipes designed to take water under the road. The pipes should be positioned on a slight slope to prevent siltation. Often protection from erosion is required at the pipe outlet and sometimes the inlet as well.

Whoa boys

Whoa boys are banks constructed across roads to intercept and dispose of water flows. They can be constructed by cutting a channel on a grade of 0.3% across the road, dumping excavated material on the downslope side and then compacting and smoothing the bank. Alternatively, imported material can be used to construct the bank. Broader banks or incorporation of ramps will improve trafficability. Whoa boys must spill into undisturbed, stable areas. A level sill can be constructed to spread water where it spills out. This can be constructed with a grader by cutting a flat drain on the contour and spilling soil on the upslope side. It is important not to disturb the disposal area when constructing banks and sills. Whoa boys must be long enough to ensure water does not return to the road.

Design and construction

As a very rough rule of thumb, erosion control banks or drains on station roads and fence lines should be spaced every 50 m on slopes less than 3% and at least every 25 m on slopes greater than 3%. Bank and drain construction should begin at the top of the catchment and proceed downslope.

A grader, dozer, loader or tractor can be used to construct banks, depending on the size of bank required, source of material and availability of machinery. A dumpy level is a good investment for obtaining appropriate bank spacings and grades. A builder’s laser level or home-made hose level can also be used. On significant slopes and erodible country, ‘eyeballing’ will not be sufficiently accurate.

Most stations use graders for road, fence line and firebreak maintenance. Grader driver training schools have been developed by NT Government Soil Conservation staff, Landcare groups and private consultants. Grader drivers are provided with information on the causes of erosion and are instructed in minimising windrow formation and using the grader to form roads and construct banks, flat-bottom drains and level sills.

On stations in tropical areas, it is not feasible to design roads and erosion control works to cope with very intense rainfall events and occasional blowouts are expected.
SUMMARY OF BEST PRACTICE

- Minimise erosion potential by locating roads and fence lines on ridgelines, avoiding erodible soils and steep slopes.
- Avoid concentrating water with windrows and build up roads.
- Construct erosion control structures on roads, fence lines and firebreaks where necessary, giving consideration to appropriate size and spacing of structures.
- Encourage grader drivers to attend an Erosion Control Workshop.
- Slash fence lines where possible.
- Spray fence lines to control weeds and regrowth without killing the grass.

Source
Darryl Hill, Soil Save, Katherine, Grader school course notes (unpublished).

Further information
Further information
Land Note ASLN-01 Road drainage, November 2006.
Land Note ASLN-02 Gully rehabilitation and stabilisation, November 2006.
Land Note ASLN-10 Repairing Tracks, Firebreaks and Fencelines to Minimise Erosion, November 2006.
Land Note ASLN-12 Water Movement and Drainage, November 2006.

Related topic
Paddock Design.
Good paddock design has profound implications for cattle management and property profitability. When opportunities arise to construct new paddocks, getting the design right is worth the effort.

**Wet and dry season grazing**

Native pasture paddocks designed for year-round grazing require areas suitable for both wet and dry season use. Cattle do not like grazing boggy areas in the wet season, so they stick to well-drained areas such as red earth, lithosol and gravelly yellow earth soils.

Soils which become boggy during the wet season include the solodics, soloths, yellow earths and those in areas which are flooded.

Fencing different land types separately is a valid strategy, particularly for properties with significant areas of floodplains, but requires careful management. Almost certainly this will involve rotational grazing on a seasonal basis.

**Quality of Paddock**

Matching the quality of a paddock to an appropriate class of animal is an important part of running an efficient cattle production system. The best quality paddocks should be allocated to weaners, heifers and steers requiring diet quality for growth. Adult breeders are generally able to maintain reasonable breeding performance in poorer paddocks when managed at conservative stocking rates, weaned appropriately and provided with mineral supplements. Breeders need to be in good, and preferably improving condition to conceive, but after that, they preferentially divert nutrients to the foetus or as milk to a calf. They gain and/or lose bodyweight during the year as a buffer.

**Water point development and paddock size**

Centrally located water points are less convenient but provide more even grazing over the whole paddock. Water point development varies significantly throughout the Darwin region. The number of water points differs according to the average size of the property, time that property development has been occurring, finance available to undertake water point development and the amount, quality of water available and the number of permanent natural watering points. According to the Pastoral Industry Survey (2004) most properties average 14 man-made water points and 24 permanent natural water sources.

Water point development needs to take into consideration the distance that cattle will walk to water.

There is a wide range in paddock numbers (1 to 59, average 19) and paddock size (1 to 300 km², average 51 km²) on Top End properties. This reflects the range of properties in the Top End from small, intensively managed to the larger more extensively managed properties. The survey also reports that paddock subdivision is a high priority for owners and managers.
Sensitive and fragile land systems, river frontage, unmanageable areas of permanent natural water or stony upland country of very low productivity require specific land management considerations, including the option of not being grazed at all.

Laneways

Despite the additional cost of constructing laneways, the savings in labour and time have the potential to out-weigh the cost. Properties are developing laneways that lead from their paddocks all the way to the yards, finding that this makes mustering more manageable.

Other methods of improving grazing distribution

Other techniques for attracting cattle to under-utilised areas within paddocks include placement of feed supplements, improvement of the attractiveness through fire and by creating roads. If cattle are readily eating supplement it can be gradually moved away from the watering point. If cattle are not readily eating supplement it can be moved closer to the water source. Rotational burning of different parts of native pasture paddocks attracts cattle to the burnt areas. The area burnt should not be too small or it can result in an over-grazed and degraded patch. Cattle, particularly Brahman, which naturally follow tracks can be encouraged to walk out by creating a track for them to follow.

SUMMARY OF BEST PRACTICE

- Growing cattle require the best paddocks. Breeders can be productive in poorer paddocks with appropriate management.
- Increasing water availability and reducing paddock size yield production advantages.
- Laneways are an excellent investment.
- Encourage cattle to change grazing areas using supplements, burning and creating tracks.

Sources


Further Information

MLA EDGEnetwork® Grazing Land Management Course.

Contact Pastoral Production Officer, DPI&F Katherine, Ph: (08) 8973 9763.

Related Topics

Cattle Yard Design, Distance to Water, Land Condition, GPS Data Collection, Grazing Strategies, Supplementation, Water Quality.
Cattle Yard Design

Trudi Oxley, DoR, Katherine

Good cattle yard facilities are extremely important for occupational health and safety and to ensure animal welfare standards are met.

A well-designed and functional set of yards should provide:

- safe, efficient handling of cattle
- good facilities for drafting and loading cattle
- good restraint for husbandry practices such as tagging, vaccinating, branding, castration, dehorning
- a safe working environment

When designing and locating cattle yards, important considerations are:

- the maximum number of cattle to be accommodated, incorporating large, cooler-type yards for big mobs
- the cost/benefit of the yard, i.e. the number of stock and the frequency of use
- water availability and provision
- provision for feeding
- materials
- animal behaviour, cattle flow, use of curved designs and visual barriers
- gate safety
- dust suppression and yard orientation
- procedures to be carried out in or around the yards (drafting, weighing, AI, NLIS, vaccinating, tagging, branding, castration, dehorning, spaying, trucking)
- access for trucks or road trains
- drainage, soil type and access if wet season use is anticipated
- cattle temperament, as handlers need larger flight zones where temperament is not good.

Using a portable yard initially can test a design before construction of a permanent set of yards. If new to the region, consider visiting other yards in the area with a reputation for working well. Consult NT Government Pastoral Production staff about yards which work well.

Location

Water availability will be a major consideration in the location of yards, as will slope and soil type if subject to waterlogging. Yards should be on country with good drainage. Most yards, regardless of land type, will become dusty if regularly or constantly used. A sprinkler system should be considered. The orientation of the yards should take into account the prevailing winds so the main work areas (crush, branding cradle and race) are not getting all the dust from back yards. Also consider prevailing winds when deciding where to yard up from as cattle prefer to travel into the wind. This will result in reduced visibility for staff yarding up. Locating the yarding-up area where there will be a cross-wind allows dust to be blown across the mob.

Materials and construction

Budget considerations will influence the choice of yard design and construction materials. Wood is rarely used in the Darwin region because of the prevalence of termites and fires and the ready availability of steel. Steel should be strong enough to prevent breakages occurring when cattle run into rails. Use of light steel is false economy in the long run. Drafting and forcing yards, for example, need to be able to withstand high pressure. Mesh and cable may suffice for coolers and weaner yards.

Construction needs to allow cattle handlers to escape from yards quickly and easily if necessary. Yards made from railway sleepers are strong and durable but can impede climbing in and out of yards and have a reputation for being hot to work in.
Portable panels are often used for trial yards, temporary yards, special purpose applications or where the expense of permanent yards cannot be justified. Caution should be exercised when using portable yards because they are generally not as strong as permanent yards. Portable panels should not be fixed in place. They are meant to flex and move and are not suitable for races and inner yards. They may cause injury if they shift unexpectedly. Some producers have a permanent core of forcing and drafting yards and the race, and use panels to make the holding yards. When taking this approach consider making gateways with permanent materials to run panels off.

Miscellaneous design and construction tips:

- A head-bail in place of a slide gate at the start of a race can control the flow of cattle more easily and avoid pile-ups of cattle in the race.
- Weld two chains on the outside of gates for extra yard security if gates are not being wired at night.
- Ensure the branding area is concreted and has access to water to allow a high level of hygiene.
- Crushes should have a built-in floor or be installed on a cement pad.
- When concreting posts, ensure the concrete is above ground level to prevent water pooling around the bottom of the post which could cause it to rust and break under pressure.
- Construction and strength of yards depends on stock density and closeness of human interaction – Outer yards can be constructed much differently and cheaper than forcing pens – Good stock handling principles can help reduce cost of construction of yards.

**Animal Behaviour**

Understanding and using natural cattle behaviour is important to the success of any yard design. The following aspects of yard design consider animal behaviour:

- Screened panels where animals are crowded together (e.g. pound and forcing yards) prevent them seeing activity that may upset them.
- A solid crowding gate prevents cattle from seeing light through it and turning towards it.
- Curved races and catwalks facilitate natural following behaviour and prevent animals seeing the crush or what is immediately ahead.

**Occupational Health and Safety considerations**

- Use trees or roofs to shade areas such as the crush and branding cradle for worker comfort and safety.
- Put a small yard around the branding cradle and crush to protect people and equipment from agitated animals.
- Ensure water is easily accessible for workers, especially in the vicinity of chemical use.
- Consider removal of a race rail to facilitate safer bang-tailing and vaccination and prevent kicking injuries.
- Suppress dust.
- Design drafting yards or use commercially available race or round-yard draft designs to reduce the need for people to be in with animals.
- Provide strategically located gates for easy access to and exit from yards. In the absence of man-gates, ensure rails allow staff to climb out of the yard safely and quickly if a worker is pursued by a beast.

**Sources**

Greg Scott, Regional Livestock Biosecurity Officer, DPI&F.
Jack Wheeler, Manager Katherine Research Station, DPI&F.
Gordon McBride, Technical Officer Katherine Research Station, DoR.

**Further information**


**Related topics**

Paddock Design, Stock Handling.
Cattle Dips

Grant Parker, formerly DPIFM Katherine

Plunge dips are the most efficient and cost effective way to control cattle tick.
It is essential that dip products are mixed and managed correctly. Overstrength and understrength dips are detrimental to productivity. Incorrect dip strength can contribute to the development of chemically-resistant strains of cattle tick.

Plunge dips are currently used at Live Cattle Export Yards and Depots, and some other properties in the Top End region.

Calculating the Dip Volume

Three different ways to determine dip volumes are by:

• using a flow meter to measure the amount of water going into the dip
• filling the dip from a tank of known capacity
• using the formula:
  \[
  \text{volume} = \text{average length} \times \text{average width} \times \text{average depth}
  \]
  (and create a ‘dip stick’.)

When the volume has been calculated, the amount of chemical required can be determined according to the manufacturer’s instructions. Never add more than the recommended amount. The topping-up rate is also determined according to the manufacturer’s instructions.

Run at least 30 head of ‘stirrer’ cattle through the dip to evenly distribute the chemical. (Amitraz plunge dips generally require more agitation). Animals used as stirrers should be returned to the main mob and dipped again. Always measure the dip level after stock have been treated and again before the next treatment to determine the replenishment rate. Overstrength dips are uneconomical due to chemical wastage, toxicity (particularly with weak or young stock), and can lead to residues in meat, potentially jeopardising markets. Understrength dips do not give a good tick kill rate and can result in delays in trucking.

Erecting a roof over the plunge dip can reduce evaporation and prevent rainfall entering the dip.

Recording

It is a sound policy to record all dip activity. This is important when several people are involved with cattle dipping. Record the date, volume, number of stock dipped, amount of chemical added, amount of liquid at completion and analytical results.

Sampling

Dip samples must be collected after the dip has been stirred. Take the sample in a wide-mouthed glass container as the last beast is still swimming from the jump-in end, around one metre out and one metre deep so that the sample is representative of the thoroughly mixed dip. Never use a container that could be mistakenly used for other purposes. The sample should be labelled with the property name, dip location, brand of chemical, sample date and contact details.

Dip samples are processed weekly at the NT Government’s Berrimah Chemistry Laboratory.

If ticks are surviving your dip treatment they may be resistant. Testing for resistance can be organised through your Regional Livestock Biosecurity Officer.
SUMMARY OF BEST PRACTICE

• Always follow manufacturer’s instructions when using chemicals.
• Maintain good records of dip activity.
• Sample the dip regularly.

Source

Further information
Regional Livestock Biosecurity Officer,
DPI&F Darwin Ph: (08) 8999 2030.

Related topics
Ticks, Tick Fever.
Dams (Excavated Earth Tanks)

Jim Addison, DAFWA Kalgoorlie

Excavated earth tanks are the most common type of stock-water dam in pastoral areas. They are favoured where ground water is either unavailable, of poor quality or supply, or at considerable depth.

Dams are an attractive option where water supplies are required at long distances from homesteads because of their minimal maintenance and monitoring requirements, especially if they are ‘walk-in’ dams. While gully dams, for example, may be more efficient in terms of an earth moved to water stored ratio, excavated tanks have much reduced evaporation (better depth:surface area ratio) and do not require a sizeable, stable by-wash. Appropriately sited, designed and constructed excavated tanks are not compromised by the high intensity rainfall events of northern Australia.

The success of a surface water harvesting/storage system depends on:
- comprehensive planning focused on landscape evaluation
- appropriate design, site surveying and pegging
- pre-construction site and soil evaluation
- construction to design criteria
- post-construction management and maintenance.

Planning

Identify the catchment using aerial photos, maps, ‘Google Earth’ and local knowledge and then locate an appropriate nearby site for the dam. Try to scope all likely sites. Ground-truth this information and select the most promising site. Match expected annual catchment runoff production to dam storage volume. Excessive volumes of runoff are difficult to manage. Catchment production is a factor of rainfall, catchment area and annual runoff efficiency. Runoff efficiency is driven by catchment soil types, vegetation type and density, topography (slope), micro-relief, and catchment shape.

Locate dams away from incised water courses where possible, as these indicate that the water flow is erosive.

A well-designed dam will reduce evaporation to 70% of that recorded with a Class A evaporation pan. Assuming a complete annual recharge, this will result in 60% of the stored water being useable by livestock and 40% lost to evaporation.

A useful livestock water consumption figure for planning is 50 L (0.05 m³) per day per animal equivalent.
Design

Design focus should be on evaporation and erosion/silting minimisation, together with efficient cost-effective earthmoving.

Minimise dam silting by using a pipe inlet to convey runoff from the catchment to the base of the dam and by using wing banks to temporarily store runoff. This allows silt to settle outside the dam. The opening to the pipe inlet should be protected with a concrete abutment to prevent damage from livestock and to keep it clear of any material which might hinder water flow. While the incorporation of a ‘trash catcher’ into the abutment design is recommended, the use of silt-pits is not.

Slope the top of the dam bank outwards to protect the inside batter from accelerated water erosion. This also reduces fouling of the water from faecal material deposited by stock on the dam wall.

Reduce evaporation losses and lower water temperature by constructing a deep dam. A depth of greater than 6m is recommended.

Minimising water surface area by keeping the inside batter slope ‘steep’ (3:1) further reduces evaporative losses. A steep batter slope also reduces the risk of livestock bogging and when used with a small dam basal area, maximises stored water depth for any given runoff event.

Reduced air flow across the water surface can be achieved by constructing a dam wall that does not incorporate a ‘berm’ or ‘table’. This also improves earthmoving efficiency.

Round dam design results in more efficient earthmoving as the excavated soil is moved the least distance. This design also negates the accelerated batter erosion often experienced in the mitre corners of square and oblong dams.

Overflow (by-wash) locations should be chosen to minimise soil erosion risks.

Site evaluation

Sites should be test-drilled to the designed depth plus one metre prior to construction, to test for soil water-holding capacity and presence or not of a salty water table or rock. A maximum of five investigative test holes is required per dam site. Soils should also be assessed for clay content, strength and dispersion in water. In general terms, preferred soils contain at least 25% clay and are of medium strength and dispersion. Medium strength clays that stiffen with hand-moulding make firm inside batter slopes.

The site should be pegged to indicate the dam centre, dam bank, inlet and wing bank locations. This information should be accurately recorded and conveyed to the earthmoving operator prior to construction. Any other works proposed in the catchment should also be pegged and recorded.
Construction

The key to successful construction is to employ a competent operator with the appropriate earthmoving machinery! Commonly, a bulldozer or bulldozer and scraper combination are used. Some bulldozer operators prefer to push material on a 4:1 batter slope for most of the construction and then cut back to the design criteria of 3:1 in the final stages. This allows most of the excavated material to be moved efficiently.

Any part of the soil profile identified as containing sub-standard material should be benched out and re-packed with good quality material.

Wing banks should always be constructed with material from the down-slope side of the bank to ensure that all water temporarily ponded by the wing banks can enter the inlet pipe by gravitational flow.

It is recommended that any quote for construction should be on a cubic metre basis for the excavation and an hourly rate for wing bank construction. A mobilisation cost will also be incurred.

Management and maintenance

Immediately following construction, the excavation should be surveyed to determine that design specifications have been achieved. This will also facilitate fair payment for the construction.

For the first year after construction and when filling, the dam should be conservatively stocked to aid inside batter consolidation. It is important to be vigilant during the first year to ensure that earthmoving machinery has not brought weed species to the site. Livestock bogging in walk-in dams may be eliminated through good design and construction and by ensuring watering stock are always in good condition.

The only maintenance required for a significant number of years should be the removal of material from the inlet pipe.

Further information

Department of Agriculture and Food, WA. http://www.agric.wa.gov.au/objtwr/imported_assets/content/lwe/water/eng/excavatedtanks2.pdf

Addison, JS, Law, RJ and Eliot, GB (2003). Dam Design for Pastoral Stock Water Supplies, Department of Agriculture, Western Australia.


Related topic

Roads and Fences.
Chapter One: Infrastructure and Station Development

How can GIS be used in the pastoral industry?
With access to geospatial datasets, GIS can be used for many purposes including:
• displaying existing property infrastructure
• locating new fence lines and calculating costs and paddock areas
• performing grazing radius calculations
• determining the location for new water points
• calculating long-term carrying capacities
• displaying fire history data
• locating sites of significance.

What is the link between a GPS and a GIS?
A GPS (Global Positioning System) can be used to capture the geographic coordinates of any physical feature or landmark. This geospatial information can then be added to a GIS and combined with other datasets (spatial or non-spatial). The data can then be used to provide further information and displayed on an accurately scaled map.

How can I get access to GIS?
A range of GIS software is available for purchase with costs dependent on the tools required and the capability of the computer. Many software companies provide training opportunities to gain operating skills either in a classroom situation or on the internet. Software used by the NT Government includes ESRI, MapInfo and ERMapper.

There are also cheaper software packages such as PAM, Fugawi and FarmMap. These user-friendly packages are often used for mapping existing infrastructure. They have limited GIS capabilities, but can perform simple tasks such as measuring between points, or along fence lines. This software is readily available, affordable, requires minimal training, and is relatively simple to import data into.

What GIS datasets are available for property owners?
A wide range of Northern Territory natural resource geospatial datasets are owned, stored and managed by NT Government departments (DLRM and DPI&F). These departments may provide access to their datasets, and a cost may be incurred. Geoscience Australia stores a large amount of geospatial data and information on their website.

The extensive catalogue of data includes:
• property infrastructure data
• cadastral information (e.g. property boundaries)
• soils, land systems and land unit data
• vegetation information
• water resources (e.g. bore locations and reports, aquifer information)
• remote sensing and satellite imagery datasets
• topographic data at various scales (Geoscience Australia).
Example of using a GIS in the pastoral industry

**Objective:**
To develop and stock a new area.

**Considerations:**
Location of fence lines and watering points to optimise paddock area and pasture use and minimise costs, erosion risk and maintenance requirements.

**Procedure:**
- Use a GPS to establish location data for current infrastructure.
- Use a GIS to collate land unit, soil type, topographic and water resources data.
- Determine the best positions for water points. Use the GIS to look at grazing distances and calculate the number of watering points required.
- Establish the best positions for fence lines in relation to soil types and topography to minimise erosion and the number of creek crossings and reduce numbers of end assemblies.
- Use the GIS to calculate paddock areas for each scenario and for rapid calculation of the costs of development using lengths of fence, poly pipe and numbers of waters required.
- Produce maps of proposals or final design for bank managers, staff, sacred sites clearances, funding or grant applications etc.

**SUMMARY OF BENEFITS OF GIS**
GIS can assist land management planning decisions by:
- assisting in the development of property management plans
- preparing budgets for infrastructure development proposals
- calculating potential fence lines, waters and grazing radius circles
- assisting in location of fences in relation to topographical features, including land and soils types
- locating sites for bores, dams and turkey nests
- producing accurate maps.

**Further information**
DLRM, Rangeland Management Branch, Katherine, Ph: (08) 8973 8842.

DPI&F, Pastoral Production Division, Katherine, Ph: (08) 8973 9763.

Geoscience Australia.  

**Related topic:**
GPS Data Collection, Paddock Design.
Chapter One: Infrastructure and Station Development

What is a Map Datum?
A map datum is a set of parameters and control points used to accurately define the shape of the earth. A map datum must always be selected on a GPS receiver before any data collection has begun.

**AGD66 – Australian Geodetic Datum 1966**
- Suitable for Australian region only.
- The origin point is approximately 200 m SW of the earth’s centre.
- Noted as AUS66 on some GPS receivers.

**WGS84 – World Geodetic System 1984**
- Origin point based on centre of Earth’s mass.
- This datum was developed for standardisation of global coordinates and compatible use of GPSs.

**GDA94 – Geocentric Datum of Australia 1994**
- The origin point based on centre of Earth’s mass.
- This datum is slightly more accurate than WGS84.
- Mapping agencies in Australia will refer to GDA94 but for practical purposes it can generally be regarded as the same as WGS84.
- Only available on new GPS receivers.

What is the difference between datum AGD66 and datum WGS84?
Coordinates will shift approximately 200 m in a north-easterly direction using datum WGS84 compared with datum AGD66. The same coordinates are displayed for both locations, so it is essential to know which datum you have selected on your GPS.

An example of using the WRONG map datum
A proposed bore is located using a GPS and the coordinates are given to the bore driller without specifying the datum used. The bore was drilled in the wrong paddock.

- Recorded location, 228828E, 839193N (WGS84 Datum)
- Bore drilled here, using the SAME coordinates as provided, but using Datum AGD66 on the GPS. This location is approximately 200 m south-west of the WGS84 datum location.

A local example of using the wrong map datum has occurred between two stations on the Sturt Plateau. The boundary fence between the properties is out by about 100 metres because the wrong map datum was used. Over a 40 kilometre fence line, this equates to 400 ha of land lost by one of the stations.

GPS Data Collection
Caroline Green and Mark Tarrant, DNRETAS Katherine

The Global Positioning System (GPS) is a worldwide satellite-based navigation system made up of a network of 24 satellites and their ground stations. The hand-held GPS receiver uses these satellites as reference points to calculate positions accurate to a distance of metres, with advanced receivers making measurements to better than a centimetre. GPS receivers work in any weather conditions, anywhere in the world, 24 hours a day. The system is managed by the United States Defence Force. There are no subscription fees or setup charges to use a GPS receiver.
What is the RIGHT map datum to use?
You can collect geographic data using a GPS for many reasons: to plot a new fence line, to locate a proposed bore on your property map, or to send information to a government agency.

Important points to note:
• If you are providing information to a third party, ask what datum is preferred.
• The datum on your GPS should be the same as the map that you are using.
• The datum is usually noted on most maps (generally under the scale bar).
• Always RECORD the datum you have selected on your GPS.

Coordinates
Geographic data can be collected with a GPS using different coordinate systems:
• latitude and longitude, measured in degrees (often called Geographic coordinates)
• eastings and northings, measured in metres (UTM Projection, often called grid coordinates)

Latitude and longitude
Latitude (lat) measures the earth’s surface in a north-south direction. The equator is 0 degrees latitude and the poles are at 90 degrees latitude. South of the equator is noted as a negative. Longitude (long) measures the earth’s surface in an east-west direction from 0 degrees long at Greenwich, England to 180 degrees east and west.

Example:
The location of Katherine, using datum WGS84 in geographic coordinates (latitude, longitude) can be written several ways:
• Decimal degrees (d.ddd) – 14.47°, 132.26°
• Decimal minutes (d.mmm) – 14° 28.2’, 132° 15.0’
• Degrees, minutes, seconds (dms) – 14° 28’ 12”, 132° 15’ 0”

Easting and northings
A mathematical projection has been used to convert the curved earth to a flat surface in measurement units of metres. The UTM (Universal Transverse Mercator) projection creates 60 zones of 6° longitude each. UTM zones 52 and 53 are used for the Northern Territory, separated by the 132° longitude. Be aware that one set of coordinates is used for all 60 UTM zones! The UTM zone is noted next to the coordinate location on your GPS.

Example:
The location of Katherine, using datum WGS84 in UTM zone 53 should be written as 205002, 8399012. (Handy hint: eastings have 6 numerals and northings have 7 numerals).

Which coordinate setting should I use?
Easting and northing coordinates are measured in units of metres and are a lot easier to plot on a map than latitude and longitude using degrees. Grid lines marked on topographic maps are also in metres and provide a good base reference for plotting coordinates.

Converting coordinates
Datums and coordinate systems can be changed after data has been collected. It is extremely important that GPS settings are not altered during data collection. If you are doubtful, continue with the same datum and coordinate system. ALWAYS record the datum and coordinate system used on your GPS for future reference. For more information about maps, datums and coordinate systems, refer to the national Mapping Division of Geoscience website.

Record your position using a waypoint
A waypoint is an averaged coordinate position that is saved in the GPS receiver memory and can be given a unique name. Descriptive information about each waypoint should be written down as it is collected. The waypoint name, an associated comment and also the order of notation are valuable pieces of information the user will need at a later time. Fewer errors are made plotting coordinates on maps or providing data to a third party when the information is clear and concise. A spreadsheet is an easy way of writing coordinates with the associated details. Alternatively, data can be downloaded directly from the GPS to a computer.

SUMMARY OF BEST PRACTICE
• If you are providing data to a third party always CHECK which datum and coordinate system is preferred.
• The datum on your GPS receiver should match the datum used on your map (usually under the scale bar).
• Select a coordinate system on your GPS.
• Do not change your GPS settings during data collection.

Further information
Geoscience Australia, National Mapping Division.

Related topics
Geographic Information Systems, Paddock Design, Roads and Fences.
Telemetry
Harmony James, formerly DRDPIFR Tennant Creek

The cost of visiting remote watering sites is high, particularly in hot, dry weather when frequent checks are essential. Telemetry is an emerging technology and one of the most important innovations in managing stock and water on large properties.

Telemetry allows remote monitoring of water using radio, satellite or telephone systems and can be capable of turning water on and off as required, as well as visualising situations via digital images. The installation of repeater units can improve the range of UHF telemetry systems. The main benefit of telemetry is savings in labour and fuel costs by reducing the amount of travel required to check watering points. Monitoring can be carried out from a base point.

Telemetry which has been trialled in the Barkly and Alice Springs regions over recent years incorporates:

- remote monitoring of the water level in a dam, trough or tank
- control and monitoring of bore pump engines
- monitoring water volume pumped from bores
- monitoring of alarms and nutrient/water usage from water medicators
- monitoring and logging rainfall from around the station to use in pasture growth prediction models
- viewing a digital photo of trough.

The technology has not been adopted by many producers because questions over reliability and development costs, and cost savings have not been fully investigated. The 21st Century Pastoralism group, based in the Alice Springs district, is currently analysing reliability and costs and benefits. At the time of writing, there are two known commercially available systems.

Average costs to install basic telemetry systems on-site are:

- Base station, servicing up to 100 watering points, from $1000.
- Monitoring system for each individual watering point, from $2000.

Source

Further information

Related topics

SUMMARY OF BEST PRACTICE

- Visit a working telemetry system before installing your own system.
- Research and weigh up the costs and benefits of a telemetry system.
- Regular visits to watering points and supplement stations may still be required to appreciate cattle and land condition.
Chapter Two: Land Management

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Land condition is the capacity of land to respond to rain and produce useful forage and is a measure of how well the grazing land is capturing energy and cycling nutrients and water.

It is also a measure of how well the grazing ecosystem is functioning. Understanding and evaluating land condition is important when managing pastoral land for a sustainable future.

**Land condition is measured by three criteria:**

- **Soil condition:** the capacity of soil to absorb and store rainfall, to store and recycle nutrients, to provide habitat for seed germination and plant growth, and to resist erosion.
- **Pasture condition:** the capacity of the pasture to capture solar energy and convert it to palatable green leaf, to use rainfall efficiently, to conserve soil condition and to cycle nutrients.
- **Woodland condition:** the capacity of the woodland to grow pasture, to cycle nutrients and to regulate groundwater.

Pasture condition assessment is based on the presence of perennial, productive and palatable grasses (3P). Assessment of annuals is less useful as these fluctuate seasonally.

**ABCD land condition framework**

Land condition can be classified into four main categories, known as the ‘ABCD’ land condition framework.

- **‘A’ condition (Good condition)**
  - Good or ‘A’ condition has all the following features:
    - good coverage of perennial grasses dominated by perennial, productive and palatable (3P) grass species for that land type
    - little bare ground (<30% in general)
    - few weeds and no significant infestations
    - good soil condition, no erosion and good soil surface condition
    - no sign or only early signs of woody thickening.

- **‘B’ condition (Fair condition)**
  - Fair or ‘B’ condition has at least one or more of the following features, otherwise similar to ‘A’ condition:
    - some decline of 3P grasses with increases in other species (less favoured grasses and weeds) and/or bare ground (generally 30–60% bare ground)
    - some decline in soil condition with some signs of previous erosion and/or current susceptibility to erosion is a concern
    - some thickening in density of woody plants.

- **‘C’ condition (Poor condition)**
  - Poor or ‘C’ condition has one or more of the following features, otherwise similar to ‘B’ condition:
    - general decline of 3P grasses, large amounts of less favoured species and/or >60% bare ground
    - obvious signs of past erosion and/or erosion risk currently high
    - general thickening in density of woody plants.

- **‘D’ condition (Very poor condition)**
  - Very poor or ‘D’ condition has one or more of the following features:
    - general lack of any perennial grasses or forbs
    - severe erosion or scalding, resulting in a hostile environment for plant growth
    - woody plants or weeds cover most of the area.
Land condition photos:

‘A’ condition  ‘B’ condition

‘C’ condition  ‘D’ condition

Degradation of grazing lands is the loss of land condition. In the early stages of degradation, the condition of land is responsive to a change in management. Degradation is judged to be severe if it is irreversible over a reasonable time scale and/or is expensive to rehabilitate.

Land in condition A is relatively stable. Land that is trending towards B can be fairly quickly reverted to A by a change in management. However, land in condition B is susceptible to a rapid decline to C. Also, reversing this change may require a major change in management and will take time to achieve. Land in condition C is very susceptible to rapid deterioration to condition D. Land in condition D will not revert to C by simply changing management; at least not in any time frame of practical interest to grazing land management. Reverting land in condition D back to C requires significant investment (time and money) into mechanical rehabilitation and even this may still be unsuccessful if soil condition is irreparable. Activities required to facilitate a shift back to condition C from D might include reseeding, earthworks and fertilisation.

It is important to distinguish cosmetic changes in land condition from real changes. For example, well-managed grazing land in condition A may appear to change to condition B during a run of dry years, but in reality maintains a good density of perennial plants and quickly resumes the ‘ideal’ look of A condition with one good wet season.

Conversely, another common misreading is that land in condition C is okay because it manages to produce green cover during a run of wet years. The reality is that if perennial grass density remains low, even with some recovery of perennial grasses, soil organic matter and biological activity; they take much longer to recover.

Land condition must be assessed according to what the land type looks like in A condition, not against what other more productive land types look like.

**SUMMARY OF BEST PRACTICE**

- Land condition can be assessed using the ABCD framework.
- Country should be managed to maintain or revert to condition A using stocking rates, fire and weed control.
- Understanding the characteristics of the land type is essential to assessing land condition.

**Sources**


**Further information**


MLA EDGEnetwork® Grazing Land Management course.

Contact Pastoral Production Extension Officer DPI&F Katherine, Ph: (08) 8973 9763.

**Related topics**

Biodiversity Conservation, Fire Management, Native Tree and Shrub Management, Native Pastures of the Top End Region, Tree Clearing on Pastoral Land, Weed Management.
Native Pasture Carrying Capacity

Trudi Oxley, DoR Katherine

Stocking according to an accurate carrying capacity calculation is critical to:

- animal productivity (per area and per head)
- long-term land and pasture condition
- productivity and enterprise profitability.

There are two main approaches to estimating carrying capacity:

- Calculate a paddock’s long-term carrying capacity, defined as the average number of animals a paddock can be expected to support over a planning horizon (5–10 years).
- Use a short-term approach, defined as the number of animals a paddock can support for a season or year.

Carrying capacity is often confused with the term ‘stocking rate’ which refers to the number of stock per unit area at a particular time. Stocking rate may or may not match the short-term or long-term carrying capacity.

Calculating long-term carrying capacity

An objectively calculated long-term carrying capacity provides a useful benchmark for individual paddocks and the property.

If you do not have the knowledge and experience of the stocking levels appropriate for maintaining or improving land condition, you will need to collect some information to allow you to calculate long-term carrying capacities.

Long-term carrying capacity depends on (a) the factors which determine pasture growth:

- current mix of land types
- condition of these land types
- climate
- evenness of use by cattle
- accessibility due to water availability and geography
- grazing strategy or method
- goals for animal production and land condition.

The formula for calculating long-term carrying capacity (in Animal Equivalents/ km²) is:

\[
\text{Expected Pasture Growth for an average year (kg/ha)} \times \frac{\text{Utilisation Rate (\%)} \times \text{Forage Demand per Animal Equivalent per year (kg)}}{\text{Utilisation Rate (\%)}} = \text{AE/km}^2
\]

DPI&F has well-researched pasture models for many areas of the Katherine region which can predict growth based on land condition, land type and rainfall. As most of the grass species are the same, and the soils are similar, these models also work for native pastures in the Top End. The difference between the Katherine region and the Top End region is, with the higher more consistent rainfall in the Top End, native pasture growth and dry matter yields are generally not limited by moisture and are less likely to vary from year to year.

For example: Using a 50th percentile growth figure (an amount of growth you could safely expect in five out of ten years) on a red soil, the above formula can be used as follows:

\[
\frac{\text{Pasture Growth (2500 kg/ha) \times Utilisation Rate (15\%)} \times \text{Forage Demand per Adult Equivalent per year (3650 kg)}}{\text{Utilisation Rate (15\%)}} = 10 \text{ AE/km}^2
\]
The resulting answer is a safe, long-term stocking rate for that particular location, land condition and soil type, assuming the paddock has sufficient water points.

Benefits of determining long-term carrying capacities

• Annual forage budgeting is not required.
• A benchmark is available for projections on capital expenditure and property valuations.
• Long-term carrying capacities provide a guide for the timing and duration of grazing in a paddock. If on occasions, the calculated carrying capacity is exceeded, closer monitoring and management of these areas may be required in subsequent years.
• An objective measure is provided which can validate your ‘gut feel’ and experience and can be passed on to others.

Disadvantages of stocking according to a long-term carrying capacity

When stocking to a long-term carrying capacity, there is potential to be overgrazed in some years and undergrazed in others. Undergrazing can result in increased fire risk and missed opportunities to increase production from the paddock. The effects of overgrazing include loss of land condition, expressed as increased weeds and unpalatable species and decreased pasture growth and reduced animal productivity.
Forage budgeting for calculating short-term carrying capacity

The number of stock able to be safely carried on an area for a short period of time requires information on:
• pasture on hand
• anticipated pasture growth
• forage quality and desired animal performance
• end of dry season yield and cover targets.

The short-term carrying capacity will usually differ from long-term carrying capacity due to variation in the distribution and amount of rainfall received. Long-term and short-term carrying capacities are related: the average short-term carrying capacity over 10 years should equate to the long-term carrying capacity.

Managers require a good understanding of forage budgeting techniques to implement a short-term approach to stocking. Forage budgeting can be learnt with minimal training and a lot of practice. Photo standards are available in many areas. A minimal approach would involve driving around the paddocks, estimating standing pasture available for grazing at the end of the wet season and then adjusting cattle numbers to ensure that residual yield and groundcover targets are met. These targets will differ according to land type and average rainfall. A rule of thumb for a black soil would be to budget on leaving about 1500 kg/ha to provide adequate residual grass and groundcover going into the next wet season. On less productive land types, a rule of thumb would be to leave at least 60% groundcover. Software is available through DPI&F for calculating forage budgets. Collection of accurate data on pasture yield and composition is required.

Forage budgeting can be applied in paddocks with a uniform land type, or in paddocks to be used for sale stock or other classes of stock whose numbers can be easily adjusted.

Advantages of using a forage budgeting approach for calculating short-term carrying capacity:
• Temporarily increased stocking rates can take advantage of ‘runs’ of better years.
• A detailed understanding of pasture condition is developed.
• Overgrazing is prevented.

Disadvantages of a forage budgeting approach:
• Frequent adjustments of stock numbers in line with forage supply are necessary.
• Requires active monitoring of forage supply, land condition and markets.

The MLA EDGEnetwork® Grazing Land Management course equips people with the necessary skills and tools to calculate both short-term and long-term carrying capacities.

SUMMARY OF BEST PRACTICE

- Attend a MLA EDGEnetwork® Grazing Land Management course.
- Stock according to accurate carrying capacity calculations.

Source

Further information
DPI&F Rangeland Management course.
Contact Pastoral Production Extension Officer DPI&F Katherine, Ph: (08) 8973 9763.


MLA EDGEnetwork® Grazing Land Management course.
Contact Pastoral Production Extension Officer DPI&F Katherine, Ph: (08) 8973 9763.

Partridge, I (1999), Managing Grazing in Northern Australia: A grazier’s guide, Queensland DPI&F.

Related topics
Grazing Strategies, Native Pasture Land Condition.
Grazing Strategies
Trudi Oxley, DoR Katherine and Arthur Cameron, DoR Darwin

Rotational grazing strategies are most common in the Darwin region with thirty six percent of producers using it. Other strategies include spelling systems (18% of properties), continuous grazing (12%), and seasonal grazing on floodplain properties (16%). Only one property was using time control or cell grazing in 2004.

Continuous grazing
A continuous grazing or set stocking strategy involves running a similar number of cattle from one year to the next in any given paddock.

Benefits of set stocking/continuous grazing
• low level of management required
• no training/re-training of animals required.

Disadvantages of set stocking/continuous grazing
• There is an increased potential for areas to be overgrazed through cattle returning year after year to preferred patches.
• Depending on how conservative the stocking rate is, there is potential for overgrazing in some years and undergrazing in others. Undergrazing can result in increased fire risk and missing the opportunity to increase production.

A continuous grazing stocking strategy has a conservative stocking rate to minimise the risk of patch grazing or decline of preferred species causing a loss of land condition in the paddock. The table below outlines the utilisation rates that can be safely used for one year’s growth. Stocking rates should be based on how much pasture is grown in 50% of years. A rotational burning system can be used where at least 25% of a native pasture paddock is burnt every four to five years to try to prevent overgrazing of preferred patches.

Safe utilisation rates for Top End region country
• Tropical tall grass: 10–15%
• Mid grasses and short grasses (red soil): 15%
• Black soil: 20–25%.

Rotational grazing
Under rotational grazing, cattle are moved to allow resting of pasture during critical growing phases. A rotational grazing system can be as complex as developing a full cell-grazing enterprise or simply involve three or four paddocks.

Benefits of rotational grazing
• The ability to keep forage in vegetative (growing) stages and reduce selection of species preventing preferred species from being grazed out.
• To improve land condition by allowing perennial pastures to replenish root reserves and be better able to withstand grazing.

While production per head may decrease there will potentially be an increase in the kilograms of beef produced per hectare.

Disadvantages of rotational grazing
• Because pasture growth is water limited for some of the year, it is not possible to keep plants continually in a vegetative (growing) state.
SUMMARY OF BEST PRACTICE

• Continuous grazing: Ensure any continuous grazing strategy has a conservative stocking rate to minimise patch grazing or decline of preferred species, causing a loss of land condition in the paddock. Base stocking rates on safe utilisation rates for one year’s pasture growth, or end of season yield and cover targets.

• Rotational grazing: Consider the effects of a rotational grazing strategy on land condition, the evenness of grazing and diet quality and animal production. Seek advice from DPI&F Pastoral Production Division, Darwin.

• Wet season spelling: Spell pastures early in the growing season. Remove animals at the second round muster and return at the following first round muster. Prioritise paddocks for spelling. Do not overgraze other paddocks to achieve spelling. End of dry season targets for yield and cover are still important for stocking paddocks during the dry season.

It is often extremely difficult to move stock during the wet season.

Although rotational grazing may be useful for improving land condition it can have an adverse effect on individual animal production because it limits an animal’s ability to select only the preferred species or parts of plants to maximise diet quality.

Rotational systems require more careful management and monitoring of pastures and animals.

Test any rotational system against the effect it will have on the three principles of grazing management: What is the effect on land condition? What is the effect on the evenness of grazing? What is the effect on diet quality and therefore animal production? If you know what you are trying to achieve with a rotational system, you can then decide at what level you should implement it. For advice, contact DPI&F Pastoral Production, Darwin.

Wet season spelling

Wet season spelling involves locking up paddocks during the growing season to allow plants to replenish root reserves and set seed.

Benefits of wet season spelling

• Allows pastures to rest, preventing overgrazing of preferred species and allowing pastures to set seed.
• Easier to implement over a whole property system than more intensive rotational systems.

Disadvantages of wet season spelling

• Cattle still have to be moved into new paddocks potentially overstocking and unsettling the animals.
• Cattle may need to be agisted, or extra numbers sold to allow resting of paddocks to avoid overstocking the remaining paddocks.
• A higher level of management is required to monitor which paddocks require spelling and planning the moving of cattle.

The best time to spell pastures is early in the growing season when plants are replenishing their root reserves. The first six to eight weeks are critical for protecting root reserves. A full wet season rest allows pastures the opportunity to set seed. A practical method of achieving this is not to return cattle to a paddock after the second round muster.

Prioritise paddocks for spelling according to land condition. Spelling will help improve pasture condition in poorer paddocks or allow enough fuel to accumulate for woody vegetation control.

It is still important to aim for end of dry season yield and cover targets to maximise spelling benefits.

Source

Further information
DPI&F Rangeland Management course.
MLA EDGEnetwork® Grazing Land Management courses.
Contact Grazing Land Management Officer DPI&F Katherine, Ph: (08) 8973 9763.
School of Agriculture and Food Sciences, Ph: (07) 5460 1660, http://www.uq.edu.au/agriculture/
Resource Consulting Services Grazing for Profit Schools, Ph: (07) 3869 3044, http://www.rcs.au.com/

Related topics
Native Pasture Carrying Capacity, Native Pasture Land Condition.
In the larger paddocks of the Top End region, a marked decrease in the amount of pasture available can usually be observed as you travel closer to watering points (known as a grazing gradient). While cattle can physically walk up to 10 km from water, most grazing occurs within 3 km of water.

**Carrying capacity and land condition**

In large paddocks with sparsely placed water points, grazing pressure around water is generally high but there may be large areas distant from water where very little or no grazing occurs. As you move closer to water points utilisation rates increase and pasture cover, yield and condition decrease.

The magnitude of these changes will be related to paddock size and stocking rate (at higher stocking rates, utilisation will be greater at any given distance to water).

It is critical to consider the area within a reasonable distance from water when calculating the carrying capacity of a paddock. If paddocks are stocked according to paddock size (rather than to the area within an appropriate distance from water), sparsely watered paddocks could be overstocked in grazed areas with a resulting decrease in land condition.

**Animal production**

Apart from reducing land condition, overstocking watering points forces cattle to walk long distances out to feed, increasing their energy expenditure. In extensive grazing systems, the energy required for walking can expend a large proportion of nutrients ingested. The additional energy required to graze a long way from water can be high and is often underestimated. This is particularly significant for much of the dry season when pasture already provides less than maintenance nutrient requirements. The extra loss of condition of breeders will affect production parameters such as weaning percentage. Examples of the increases in energy expenditure with the distance walked are shown in Table 1.

**Table 1** Relationship between distance walked and energy expenditure (Dept of Agriculture WA 2005)

<table>
<thead>
<tr>
<th>Distance walked (km/day)</th>
<th>Increase in energy expenditure (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 (penned)</td>
</tr>
<tr>
<td>3</td>
<td>+3%</td>
</tr>
<tr>
<td>6</td>
<td>+22%</td>
</tr>
<tr>
<td>9</td>
<td>+33%</td>
</tr>
</tbody>
</table>
Planning for infrastructure development

According to the Pastoral Survey 2004, 96% of producers in the Darwin region thought five kilometres was enough distance for cattle to walk out from waters: a trade off between productivity and costs when planning water point development.

Software such as BreedcowDynama is available to help weigh up the costs and benefits of infrastructure investment against improved production.

There are mixed feelings among pastoralists as to whether increasing the number of water points within a paddock will effectively move cattle around a paddock because cattle tend to have preferred areas. A combination of burning, supplement and correct handling/tailing to settle cattle onto new areas can help prevent them from returning to their preferred camps on an old water point. Some pastoralists believe fencing is the only way to keep cattle on new water points. However, at Rockhampton Downs on the Barkly Tableland, a rotational waters trial demonstrated that cattle can be trained to move between waters. At Pigeon Hole in the VRD, the results showed, that to maximise evenness of use, the distance between water points should not exceed approximately 4–5 km (grazing radius of no more than 2.5 km).

Biodiversity

The rapid increase in infrastructure development in the Top End region will affect some species of plants and animals whose preferred habitat has only ever been lightly or never grazed. Most species, however, don’t appear to be affected by grazing (Biograze, 2004).

Galahs and wiregrasses are examples of ‘increaser’ species around watering points and finches and kangaroo grass are examples of ‘decreasers’ around watering points under grazing. Frequency of species such as ants and butcher birds don’t appear to be affected by grazing.

When planning grazing management there are opportunities for areas away from watering points to be identified and for some of this area to be conserved for native plants and animals.

SUMMARY OF BEST PRACTICE

- Consider the area within a reasonable distance from water when calculating carrying capacity, not paddock size alone.
- Research has shown that, to optimise evenness of use, distance between water points should not exceed 4–5 km.

Sources


Hunt, LP (2007). Options for managing grazing distribution. In Grazing Strategies for Tomorrow, DPIFM.


Further information

Biograze.

Breedcow and Dynama.

MLA EDGEnetwork® Grazing Land Management courses. Contact Pastoral Production Extension Officer DPI&F Katherine, Ph: (08) 8973 9763.

Related topics

The use of fire in the landscape
Before humans inhabited Australia, fires were mainly caused by lightning late in the dry season. Since human occupation, people have burnt the landscape for many different purposes. Fire is a useful management tool on pastoral lands. Strategic burning is carried out for several reasons.

Wildfire prevention and control
The adoption of a strategic and controlled burning program will break up the country and assist in the prevention of large wildfires. Burning during the wet season and early dry season creates cool and patchy fires that assist in reducing fuel build-up and preventing wildfire spread. In the event of advancing wildfires, backburning from strategic firebreaks is often the only control option. According to the Pastoral industry Survey of 2004, the average proportion of a Top End property burnt by wildfire each year was 19 percent.

Manipulating cattle distribution
Cattle are attracted to areas that have been burnt. Burning a long way from water or in less preferred land types encourages their use by cattle. Burning also reduces patch grazing in pastures because cattle graze the new shoots more evenly.

Improving pasture quality
Fire removes old and rank, low-quality grass and promotes green, nutritious regrowth. Fire can promote better weight gain in cattle by improving pasture quality.

Modifying pasture composition
The proportion of annual sorghum can be greatly decreased if it is burnt before it sets seed. The most effective practice in the Top End is an early wet season burn after the annual sorghum has germinated and is up to 150 mm tall, when there are still the dry residues of the previous season’s growth to supply fuel for an effective burn. More palatable plants can benefit from fire because cattle are less selective when grazing regrowth. Fire has been used to reduce the proportion of black spear grass in kangaroo grass-black spear grass pastures.

Managing native trees and shrubs
Most trees and shrubs are sensitive to fire when they are less than two metres high. A lack of fire can lead to an increase in woody plants, increasing mustering costs and reducing pasture growth and carrying capacity. Periodic hot fires can help keep woody plants in balance. The type of country and seasons (fuel load) will determine how often a hot fire can be generated without having an adverse effect on pastures.

Weed management
Fire can be used as part of an integrated weed management strategy. Bellyache bush plants are sensitive to fire.
Establishing and maintaining sown pastures
Fire can be used to create a favourable seedbed for sowing legumes such as the stylos and Wynn cassia by removing litter and reducing competition from native perennial grasses. Fire can also be used to maintain a good balance of grass and sown legume.

Biodiversity conservation
A range of different fire frequencies, intensities and timing of burns may help conserve biodiversity.

Effects of fire on country

Time of year
Burning during the wet season or early dry season creates cooler, more patchy fires which are good for promoting better pasture quality, reducing wildfire frequency and promoting biodiversity. Burning during the late dry creates intense, hot fires which are best for controlling woody plants. They can reduce biodiversity if they are too often and extensive. Late dry fires can also increase soil erosion and water run-off in the following wet season because of the lack of soil cover early in the wet season.

Frequency of burning
Burning too often can lead to an increase in annual grasses, overgrazing, reduced soil cover and loss of biodiversity.

Vegetation
Vegetation in poor condition with annual pastures should not be burnt as this can kill annuals, resulting in bare ground. Woody plants respond differently to fire depending on whether they are killed or re-sprout after fire. Re-sprouting plants are very fire resistant but fire can be used to reduce their cover and competition with pasture. Woody plants that are susceptible to fire, such as Acacia species, are often killed but fire can promote germination of seed and the establishment of new plants. These species can be managed by having consecutive fires to kill the next generation before they set seed.

According to the Pastoral industry Survey 2004, an average of only 13 percent of Top End properties was intentionally burnt each year; mainly to reduce fuel on firebreaks, freshen up native pasture and control woody weeds.

How to burn
The optimal fire management depends on the vegetation type, season and management goal. Recommended fire frequency to control woody plants (without damaging pastures) for high rainfall areas (>700 mm) is two to five years.

Pre-fire management
Grazing must be managed to ensure there is at least 1500 kg/ha of fuel and 50% cover to carry a fire. Depending on the condition of your pasture and stocking rates, spelling may be needed to allow fuel to build up. Ensure fire breaks are in place and that you have the appropriate fire permits. Burning conditions needed depend on the management objective (see table).

Post-fire management
Ideally, paddocks should be spelled after fire to allow pasture to regenerate. If only part of a paddock has been burnt make sure that cattle numbers are adjusted to prevent overgrazing of the freshly burnt area.
SUMMARY OF BEST PRACTICE

• Fire is an important management tool on pastoral enterprises.
• Consult research information for recommendations for fire frequency and intensity appropriate for your area and type of country.
• Design a fire regime to suit your country type and management goals.

Sources


Further information


MLA EDGEnetwork® Grazing Land Management course. Contact Grazing Land Management Officer DPI&F Katherine, Ph: (08) 8973 9763.


Partridge, I (1999), Managing Grazing in Northern Australia: A grazier’s guide, Queensland DPI&F.

Related topics

Biodiversity Conservation, Native Pasture Land Condition, Native Tree and Shrub Management, Rangeland Monitoring.
Environmental Management System

Trisha Cowley, DoR Katherine

What is an EMS?
An Environmental Management System (EMS) is a tool for identifying, documenting and managing the impacts of an organisation’s activities on the environment. It provides a structured approach to planning and implementing environment protection measures. Just as a financial management system monitors expenditure and income and enables regular checks of a company’s financial performance, an EMS monitors environmental performance.

An EMS integrates environmental management into a business’ daily operations, long-term planning and other quality management systems.

What is ISO 14001?
ISO stands for International Organization for Standardisation. The formal title of ISO 14001 is Environmental Management Systems - Specification With Guidance For Use. Certification to ISO 14001 is the most formal of EMS. It is intended to provide organisations with the elements of an effective environmental management system.

On an international scale, ISO 14001 aims to support environmental protection and prevention of pollution in balance with socioeconomic needs. Verified implementation of this standard can be used by businesses to assure stakeholders, markets, administrations and interested parties that an appropriate environmental management system is in place.

How does an EMS work?
An EMS is based on a ‘plan-do-check-review’ cycle and aims to achieve continual improvement in environmental, production and marketing performance. An EMS develops a system which allows businesses to:

• assess a business’ potential and real environmental impacts
• identify legal requirements and obligations relating to environmental management
• develop goals
• develop action plans addressing activities with a significant impact on the environment or which incur legal responsibilities
• monitor the success of strategies developed to address issues
• review the competence of your system, allowing for continual improvement.

An EMS can include best management practices and codes of practice and may be readily integrated with other existing activities such as quality assurance schemes. Under an EMS, diverse management issues can be drawn together under a common approach.

An EMS is not a standard to which businesses must adhere, but rather a system of continual improvement which allows the identification of relevant issues and setting of environmental targets.
Benefits of an EMS
There are many potential benefits to implementing an EMS:
- improve natural resource condition
- retain or improve access to natural resource base
- enhance image of primary producers as responsible land managers
- regulatory relief
- cost saving through improved production efficiencies
- improve business planning
- market advantages
- increase access to government funding for on-ground natural resource management
- benefits of integrating EMS with other management systems to form whole of property management system
- acknowledgement of responsible land management through accreditation.

Level of implementation
There are many degrees to which an EMS can be developed. It can be a simple plan of environmental management for use within the business, it may be externally audited or it may even be certified to ISO 14001 or to specific customer and/or industry requirements.

An EMS can be implemented to whatever level the landholder desires. Certification to ISO14001 is a complex and time-consuming procedure requiring high levels of documentation, reporting and external auditing. To reduce costs, producers can implement an EMS to ISO14001 standards but not seek accreditation. Alternatively, if producers simply wish to gain the benefits of improved environmental management and business planning they can implement an EMS as a property management plan which doesn’t involve detailed documentation and reporting.

Limitations of EMS
The reasons for low adoption rates of EMS in the Darwin region are probably:
- complexity and time-consuming task of ISO14001
- lack of EMS frameworks relevant to the northern extensive pastoral industry
- lack of market benefits to the northern beef industry
- insufficient justification for effort required to develop an EMS.

Support available
The Department of Agriculture, WA has developed a comprehensive guide for pastoralists wishing to implement an ISO14001-standard EMS. The Centralian Land Management Association has developed a simpler customised EMS template for the Central Australian region, which is still relevant to northern cattle operations. Consultants are available to help land managers develop and implement an EMS for their station.

Sources
Australian Government Department of Sustainability, Environment, Water, Population and Communities.


Further information
The Australian Landcare Management System.
http://alms.org.au


Centralian Land Management Association, Alice Springs Ph: (08) 8953 4230.


NSW Department of Primary Industries.

Rural Industries Research and Development Corporation.


Related topics
Biodiversity Conservation, Native Pasture Carrying Capacity, Fire Management, Grazing Strategy, Native Pasture Land Condition, Native Tree and Shrub Management, Rangeland Monitoring, Weed Management.
What is biodiversity?
Biodiversity is the variety of all life forms.

It includes:

- the genetic variation within species
- all species of plants, animals and other organisms
- all habitats (land types, ecosystems)
- all the processes linking species and habitats, such as nutrient recycling and the provision of clean water.

How can land managers contribute to the conservation of biodiversity in the NT?

The Northern Territory is unique in having most of its natural vegetation and freshwater ecosystems intact. Land management practices such as management of weeds, feral animals, fire, grazing, tree clearing, improved pastures and infrastructure development can all influence biodiversity outcomes. Local Landcare or conservation group facilitators can assist in sourcing funding for biodiversity conservation projects on property.

What can you do to optimise biodiversity conservation on your land?

Manage for good land condition

Many activities producers are already carrying out to ensure sustainable productivity on land will also contribute to the maintenance of biodiversity. For example, managing weeds, feral animals, fire and grazing to maximise land condition is good for cattle production and good for biodiversity. Different plants and animals require different habitats: some prefer regularly burnt areas and some prefer areas that haven’t been burnt for a long time. Some require both open areas (to forage) and dense grassy areas (to nest). Cool fires burn patchily and create a diverse habitat that suits a many different species. Similarly, a variety of grazing regimes support more species than an even level of grazing because some plants and animals occur in heavily grazed areas, and some only in very lightly or ungrazed areas.

Identify areas of high conservation value

Species and habitats vary in their importance for biodiversity conservation. Some places and species require more management effort because they have high conservation value or are particularly susceptible to damage. DLRM have maps of areas of special conservation value for each bioregion in the Territory.

They include:

- vulnerable and endangered species
- rare vegetation and habitat types, especially where these are not already represented in the current reserve system
- areas with high species diversity or large breeding populations
- waterways and associated wetland and riparian areas.

‘Refuge’ areas with historically low grazing pressure are also significant for biodiversity.

Identify potential threats to areas of high conservation value

Some management can have a negative impact on biodiversity. Careful assessment of your property to identify areas of particular conservation value can help you manage for productivity and conservation.
Potential threats to biodiversity include weeds, overgrazing, grazing in sensitive areas, unmanaged fires, feral animals, tree clearing, sowing pastures and adding waters to areas previously remote from water.

**Develop an adaptive management plan to protect areas of conservation value on your land**

Sometimes the best way of managing an area for conservation outcomes is not immediately apparent. There may be little information about optimal management of a habitat or species of interest. In this case, implementing an adaptive management approach helps to provide information about whether the management you have put in place is working to achieve your desired outcomes.

The steps in adaptive management are:

- Develop a plan, including identification of species and habitats of interest, appropriate management and monitoring.
- Implement the plan on your property or as part of a group across the catchment.
- Use information from monitoring to measure the plan’s effectiveness.
- Distribute findings to all those who took part.
- Review the plan and make changes if necessary. Adopt changes into a new plan and implement.

**Work with your neighbours**

Developing joint management strategies for weeds, feral animals, riparian areas and fire (for example) with your neighbours and across your local catchment can maximise land management and biodiversity outcomes.

**Examples of activities to conserve biodiversity**

- Fence off major waterways and wetlands completely to exclude grazing, or partly to allow controlled grazing in sensitive areas.
- Retain some areas with little or no grazing pressure. If adding waters to previously water-remote areas, fence off a small area from grazing to be used solely for the conservation of biodiversity.
- Rest large areas of country through rotational grazing and spelling of paddocks.
- Control weeds and feral animals.
- Maintain diversity of habitat through diversity of fire and grazing regimes.

**Further information**

Tropical Savannas CRC, *Land Management in northern Australia.*
http://www.landmanager.org.au


DLRM, Biodiversity Conservation Division (North), Ph: (08) 8995 5000.


Landcare.

**Related topics**

Native Pastures of the Top End region

Trudi Oxley, DoR Katherine and Arthur Cameron, DoR Darwin

Native pastures are a valuable asset on extensive pastoral properties in the Top End region. These pastures consist of a variety of species depending on soil type, topography and rainfall. Managing native pastures for sustainable long-term production requires understanding their growth phases and ecology.

Characteristics of native pastures

Pasture species are mostly either annual or perennial. Perennial grasses live for more than one year, and grow each year from the energy and nutrients stored in the root system. It is important to allow perennial grasses to seed every few years to ensure new seedlings are recruited to maintain the population. Perennial grasses are the most stable component of the pasture and provide the bulk of feed throughout the dry season. The most valuable palatable perennial grasses in the Top End are Plume sorghum (Sarga plumosum) and Kangaroo grass (Themeda triandra).

Annual grasses are those which live for less than one year and therefore need to regrow from seed every year. Whilst cattle production on annual-dominated pastures can be higher in the short-term, annual species tend to disappear during the dry season leaving bare ground.

Legumes are plants which are able to fix nitrogen due to a symbiotic relationship with soil bacteria. They have a relatively high protein content and are extremely important for diet quality. Management of pastures should aim to maintain these preferred plants, which include native Desmodiums and Vignas.

Native pasture species in the Top End region have evolved to be extremely efficient at capturing water and sunlight to facilitate rapid growth over the short growing season. A downside of this characteristic (for cattle production) is that the plants are also very efficient at relocating nutrients from above-ground leaves and stems into the roots at the end of the growing season. The standing dry matter in the dry season tends to be of low quality. Quality is reduced even further when, at the end of the growing season, the plant becomes dormant. At this time, approximately 60% of the plant will be made up of low digestible structural material such as lignin and cellulose.

Palatability

Annual grasses tend to be more palatable than perennials as they are shorter, have less indigestible material and have more concentrated nutrients. Palatability varies between perennial grasses according to factors such as their leaf:stem ratio, physical characteristics of leaves (sharp, hairy etc) and nutritive value. Native pastures need to be managed to maintain a high component of 3P grasses (palatable, productive, perennial) for optimum long-term cattle production.

Phases of pasture growth

The life cycle of a native perennial pasture plant in the Top End region can be described in four phases. Figure 1 illustrates the changes in digestibility and metabolisable energy of pastures occurring across the four phases of growth.
Phase 1 (Crude protein content 10–16%)
The plants in Phase 1 have the highest palatability and nutrient content. Animal production is limited by low yields. Plant growth occurs from the nutrients stored in the roots. This phase is the most vulnerable to grazing. Repeatedly grazing plants down at this phase will deplete the root reserves before the plant has sufficient leaf area to produce energy for growth and replenishing root reserves. Spelling pasture during Phase 1 to prevent overgrazing of individual plants can be beneficial for both the pastures and production.

Phase 2 (Crude protein content 8–10 %)
Yield is rapidly increasing in this phase and while not as good as in Phase 1, pasture quality is still high. This high quantity and quality mean Phase 2 is good for cattle production. The plant is actively placing nutrients into its root system as well as producing a high proportion of leaf in this stage, making it a good time to get maximum benefit from spelling.

Phase 3 (Crude protein content 6–8%)
Quality rapidly declines in this phase making feed quality lower. Plants are setting seeds and replenishing root nutrient reserves. Yield is high but digestibility is decreasing rapidly. Plants are less susceptibility to grazing than the previous two phases. Spelling or reduced grazing may be desirable to allow seed set.

Phase 4 (Crude protein 2–6%)
Plants in Phase 4 have low digestibility and nutrient levels. Cattle are often physically unable to eat the amount of grass required to gain sufficient energy and protein requirements and require supplementation. The plant is dormant, with nutrients and energy stored in the roots. The plant is tolerant of fire or heavy grazing, but cover levels should be maintained to prevent erosion when the first rains come.

Figure 1. Changes in digestibility and metabolisable energy of pastures over time (MLA 2003)
Pasture production across the Top End region

The amount of dry matter, or bulk, produced varies considerably according to land and soil type. On the stony ridges, dry matter production is often only 2000 to 3000 kilograms per hectare, while on more fertile creek flats it can be 5000 to 8000 kg/ha.

The quality of pasture also varies. Plant growth tends to be limited by nutrients rather than moisture. Under these conditions nutrients are diluted in structural plant material and a large quantity of low quality dry matter is produced. The region has a protein ‘drought’ every year, during each dry season.

Native pasture species

It is important for animal production, and for biodiversity, to maintain a wide variety of species in a pasture community. Widespread perennials include black spear grass (Heteropogon contortus), kangaroo grass (Themeda triandra), giant speargrass (Heteropogon triticeus), perennial sorghum (Sorghum plumosum) and the ribbon grasses (Chrysopogon fallax and Chrysopogon latifolius).

Annual sorghums, predominantly Sarga intrans are palatable and productive for only 2 to 3 months early in the wet season.

Learning to identify key pasture species enables better prediction of diet quality and monitoring of land condition. There are some excellent pasture identification books and courses relevant to the Top End region (see Further information).

SUMMARY OF BEST PRACTICE

• Be able to identify key pasture species.
• Protect pastures in Phase 1 of growth from heavy grazing.
• Allow perennial grasses to seed periodically.
• Maintain 3P grasses for sustainable production.

Sources


Further information


MLA EDGEnetwork® Grazing Land Management course. Contact Pastoral Production Extension Officer DPI&F Katherine, Ph: (08) 8973 9763.
MLA EDGEnetwork® Nutrition EDGE. Contact Pastoral Production Extension Officer DPI&F Katherine, Ph: (08) 8973 9763.

Milson, J (2000). Pasture plants of north-west Queensland, Department of Primary Industries, Natural Resources and Mines, Brisbane.
Petheram, R and Kok, B (2003). Plants of the Kimberley region of Western Australia, University of Western Australia Press, Crawley.

Related topics

Rangeland Monitoring

Robyn Cowley, DoR Katherine

Monitoring or regular observations of native pastures are an integral component of pastoral land management. The information gathered from monitoring, such as how the rangelands respond to the pressures placed on them, can be used to make informed management decisions.

Monitoring programs can help to answer questions such as:
- How many head can I carry with existing and available feed?
- Should I start to sell stock or buy feed?
- How will my management changes affect this paddock?
- Is my management causing an increase in unwanted grasses and weeds?
- Is woody growth increasing?
- Is pasture condition improving or declining?

Pastoralists should assess the general condition of their paddocks regularly.

Information from monitoring can provide base information on:
- pasture condition
- early warning signs of issues such as feed gaps, weed invasions, woody increase and erosion risk
- data to help make better management decisions
- a means of measuring change over time
- information for future reference
- a better understanding of the whole grazing system.

Visual comparison from previous assessments can show pasture condition trends. Sites should be reviewed at key times for decision-making at least annually. Monitoring can also feed into environmental management systems.

Monitoring site location

Monitoring sites should be in the major vegetation types in each paddock. The location should take into account the typically grazed areas in relation to watering points, allowing for preferentially grazed species. Sites are usually placed at an intermediate distance from water. Sometimes sites may be located in special interest areas. Sites should be marked with brightly painted pickets to ensure high visibility.

Monitoring time

In the Top End region, perennial and annual species ratios can be determined by monitoring at the end of the growing season. Monitoring at the end of the wet season ensures information is timely for use in management decisions.

Monitoring techniques

Photographic monitoring provides an objective record of vegetation change. Rainfall data and grazing information for the year relating to the sites photographed should also be recorded to assist in analysis.

Two photos can be taken from different angles. All monitoring photos should be clearly marked with a site name and date.
Rangeland Monitoring

Examples of photo standards:
2000 kg/ha (left), 2400 kg/ha (right).
(Source: From Johnson 2002).

Taking a landscape photograph from a photopoint marker, with the top of the sighter post in the centre of the viewfinder and focus on infinity.

Taking the ‘trayback’ photo with viewfinder centered on the base of the sighter post.
(Source: Queensland Department of Natural Resources 2006)

**Records management**

Use sheets to record data from each site. Ensure each recording sheet has the date, property name, paddock name, site number, a brief description of the land type and any comments which may be useful. You may also wish to note whether grazing has occurred and details of stock movements. Photos should be marked clearly with site identification and date.

Data can be collected on palm top computers and downloaded.

**Standing feed estimates**

Standing feed can be estimated with the use of photo standards. The North Australian Grassland Fuel Guide (Johnson, 2002) and the Queensland Department of Primary Industries and Fisheries (QDPI&F) provide photo standards and the corresponding pasture yields on a CD-ROM. With some training and practice you can quickly become proficient at estimations. Attending an MLA Grazing Land Management or NutritionEDGE® course will provide training and advice on how to make standing feed estimates. Software is available to assist with record keeping.

**SUMMARY OF BEST PRACTICE**

- Monitoring and regular observations of the pasture resource are an integral component of pastoral land management.
- Choose a monitoring site which represents the major vegetation types in the paddock, and which is an intermediate distance from watering points.
- Keep good records including photos and rainfall climate and grazing information.

**Sources**


**Further information**


MLA EDGEnetwork® Grazing Land Management courses. Contact Pastoral Production Extension Officer DPI&F Katherine, Ph: (08) 8973 9763.


Land Condition Photo Standard for the Burdekin Dry Tropics Rangelands (2009), Burdekin Solutions Ltd and Queensland DPI&F.

**Related topics**

Biodiversity Conservation, Fire Management, Native Pasture Land Condition, Native Tree and Shrub management, Native Pastures of the Top End, Weed Management.
Tree Clearing

Arthur Cameron, DoR Darwin and Peter Clifton, DNRETAS Palmerston

Tree clearing on properties is undertaken for infrastructure development and for the establishment of improved pastures and crops. Improved pastures are sown to increase carrying capacity, to improve animal production or for special use areas such as laneways, holding paddocks and hay paddocks.

There is a legal obligation to formally apply for approval for tree clearing operations.

The nature of properties involved in cattle production in the Top End Region is diverse. The approval of tree clearing is governed by the zoning of the property.

A clearing application must be made to the Pastoral Land Board for Pastoral Lease Properties, and to the Department of Lands, Planning and Environment for all other properties.

Approvals of clearing application are made under the Pastoral Land Act by the Pastoral Land Board for Pastoral properties, under the Planning Act by the Minister for Lands and Planning (DLPE) for properties on Unzoned land and under the Planning Act by the Development Consent Authority for properties on Zoned land.

All clearing must demonstrate consistency with the Land Clearing Guidelines (see DLRM website).

If in doubt as to whether or not approval is required, check with DLRM.
Tree Clearing

The approval process

Planning
Planning is the most important step in developing a clearing proposal. The risk of soil erosion, sedimentation of waterways, weed infestation and biodiversity loss can be minimised by sound planning. An appropriate plan will protect fixed improvements, reduce maintenance costs and maximise efficiency.

When developing a land clearing plan, focus on:
• the desired result
• plan components such as site selection, timing of clearing, clearing method, erosion control and environmental protection, ongoing management of regrowth
• the availability of advice and assistance
• fire management
• biodiversity considerations (variety and variability of plants, animals and other living organisms and the ecosystems in which they occur).

Application form
Once a plan has been developed, an application form must be submitted to the Pastoral Land Board or the Development Assessment Services of DLPE to obtain formal approval to clear. Clearing must not commence until formal approval, in the form of a Land Clearing Permit, is granted. Application forms are available from DLRM or on their website.

Property management plan
In addition to the application form, a property management plan for land clearing is required. This will provide details such as an overview of the proposed clearing and its place in whole property management, costs and benefits of the development, details of proposed clearing, what the potential impacts of the development are and how they will be mitigated, and ongoing resource management. It may also require a Pasture Development Plan if the clearing is being carried out to sow improved pastures. A template and more details for the property management plan are also available from DLRM.

Lodging the application
All required details must be completed on the approved forms and all relevant supporting information attached. An application fee is charged. Written notification of the determination is provided. If the application is approved, a Land Clearing Permit will be issued which will list any conditions applying to the approval. A clearing plan showing the areas approved for clearing will be provided. If an application is refused, the notice of refusal will list all reasons for the refusal.

SUMMARY OF BEST PRACTICE
• Best Practice is all about minimising the impact of developments. Plan clearing operations carefully. Identify potential impacts from the development to wildlife, soils, waterways, heritage sites, neighbours and the general public. Outline how potential impacts will be minimised (i.e. what actions you will take to stop an impact occurring or minimise the damage). Identify areas that may be important for wildlife, or can be used to “buffer” the potential impacts to streams or neighbours, and consider retaining these areas.
• Use DLRM expertise and website to assist with preparation of clearing plans, property plans and application forms.
• Use DPI&F expertise to assist with preparation of property plans and pasture development plans.

Sources
NT Pastoral Land Board.

Further information
Land Resource Management, DLRM
Ph: (08) 8999 5511
Pastoral Land Board Ph: (08) 8999 4667.

Related topics
Biodiversity conservation, Paddock Design, Introduced Pastures for the Top End, Weed Management.
Introduced Pastures for the Top End region

Arthur Cameron, DoR Darwin

Beef in the Top End region is produced on both native pasture and introduced pastures. Production from native pastures is variable, due mainly to the length of the wet season. Except for a brief period at the beginning of the wet season, the nutritional value of native pasture is low. Introduced legumes increase the quality of feed available, and may increase the amount, while introduced grasses increase the amount of feed available and may increase the quality.

On larger, more extensive properties, production can be improved by introducing tropical pasture legumes (augmentation) into native pasture. Legumes suitable for this purpose are Caribbean stylos (Amiga and Verano), the Shrubby stylos (Seca and Siran) and Wynn cassia. They can be established into native pastures by sowing seed into the ash after a burn early in the wet season, followed by wet season grazing to reduce competition from the perennial grasses. On extensive grazing properties, fully improved pastures would generally only be sown for a specific purpose such as a bull paddock, a steer paddock, a weaner paddock, for hay production, or to prevent erosion in laneways and holding paddocks.

On smaller, more intensive properties, fully improved pastures of legumes, grasses or a mixture of both can be established for grazing and/or hay production.

The species of improved pasture to use depends on rainfall. The Pasture Species Sowing Guide for the Top End Agnote, and the individual Agnotes for each pasture species or cultivar give the most suitable rainfall ranges for each species.

Grasses

Introduced grasses will not generally establish successfully without some form of cultivation. It is recommended that advice from DPI&F be sought prior to establishing an introduced pasture. The most successful introduced grasses are perennial, palatable, digestible, drought-tolerant and can withstand heavy grazing.

The most commonly used grasses are Jarra (Digitaria milanjiana), Tully (Urochloa humidicola), pangola (Digitaria eriantha), buffel grass (Cenchrus ciliaris) and sabi grass (Urochloa mosambicensis). More recently Strickland finger grass (Digitaria milanjiana) has shown promise.
**Legumes**

The most successful legumes in the Top End are biennials and short lived perennials. The recommended legumes for grazing are Verano and Amiga stylos (*Stylosanthes hamata*), Seca and Siran stylos (*Stylosanthes scabra*) and Wynn cassia (*Chamaecrista rotundifolia*). These are often used together.

The main legumes suitable for making hay are the annual cultivars Cavalcade and Bundey (*Centrosema pascuorum*).

Leucaena (*Leucaena leucocephala*) is a high quality shrub legume which is suitable for fattening cattle. Growing leucaena is a specialist enterprise most suitable for producers with a farming background. A high water table or irrigation is needed to keep leucaena productive in the dry season. Leucaena does not tolerate waterlogging.

**The value of improved pastures**

Direct benefits of improved pastures include increased carrying capacity (14 to 40 times the carrying capacity of native pastures) to 1 animal equivalent per hectare, increased growth rates, increased pregnancy rates and increased branding rates.

Indirect benefits of improved pastures include quieter stock, fewer deaths, easier mustering and earlier marketing of steers.

Disadvantages of improved pastures include high initial development costs to clear and develop land; a risk of soil erosion during establishment; the area improved will be out of production for at least the first wet season and most of the first dry season. There are annual or regular maintenance costs for fertilisers and herbicides.

**SUMMARY OF BEST PRACTICE**

- On larger extensive properties, use legume augmentation or sow special purpose pastures.
- On smaller properties, consider use of fully improved pastures.
- Use adapted pasture cultivars.

**Further information**

Contact Pastoral Extension Darwin
Ph: (08) 8999 2302 or 8999 2214.


Cameron, AG (2003). *Pasture establishment*, Agnote No. E97, DoR.


DPI&F Rangeland Management course.
Contact Pastoral Production Extension Officer DPI&F Katherine, Ph: (08) 8973 9763.

MLA EDGEnetwork® Grazing Land Management courses.
Contact Grazing Land Management Officer DPI&F Katherine, Ph: (08) 8973 9763.

**Related topics**

Grazing Strategies, Hay: Buying and Producing, Weaner Management.
Native Tree and Shrub Management

Robyn Cowley, DoR Katherine

Trees and shrubs are important in the savanna rangelands, contributing to water and nutrient cycles, preventing erosion and salinity, storing carbon and enhancing soil condition. Trees also provide shade and topfeed for cattle and habitat for biodiversity. Tree and shrub density and cover fluctuate with climate patterns, fire regimes and grazing.

In northern Australia woody cover and density have increased on many valuable pastoral land types that were previously open grasslands, such as the alluvial and basalt black soil plains and watercourses. A study in the VRD and Kimberley found that on average woody cover had increased between the 1940s to 1990s by 150%.

**Why has woody cover changed?**

Woody cover and density are naturally higher in higher rainfall areas and lower on clay soils. In any given region there can be woody thickening during higher rainfall periods and thinning during drought. Fire helps to manage the tree-grass balance by killing woody plants or reducing their size. The exclusion of fire may lead to woody thickening.

Reasons for the increase in woody cover in the Top End region are uncertain but are thought to be a combination of higher than average rainfall since the 1970s, the deliberate exclusion of fire from productive native pastures and the effect of grazing on fire frequency. Grazing is associated with decreased fire frequency, intensity and continuity through decreased fuel loads and control and prevention measures. It is also possible that higher CO₂ levels in the atmosphere have contributed to increasing woody cover.

Repeated late dry season burns may result in decreased woody cover.

**Effect of woody thickening and thinning**

Where woody thickening has occurred, mustering costs are increased by up to 30%. Pasture growth may be limited because woody plants compete with pasture for water and nutrients. Land condition and carrying capacity can decline and there is a loss of habitat for species that require open grasslands.

**Management options for woody thickening**

The most economic and environmentally sustainable way to control woody thickening is with fire. Recommendations for fire regimes to manage woody thickening have been developed. In general, hotter fires later in the dry season are the most effective for controlling woody thickening. Regular early dry-season burns may also help to reduce woody thickening. These recommendations were prepared before the emergence of climate change as a national issue. It is possible that changes may be made in the future in line with climate change policies.

Tree clearing requires approval. Clearing can be uneconomic on extensive properties due to the cost of controlling regrowth.
Native Tree and Shrub Management

Images show increasing tree and shrub cover over 30 years.

1968

1990

1998

**SUMMARY OF BEST PRACTICE**

- Fire is the best tool to manage woody plants.
- Burning in the late dry season at regular intervals can suppress woody plants.

**Sources**


Lewis, D (2002). *Slower Than the Eye Can See: Environmental change in northern Australia’s cattle lands*, Tropical Savannas CRC.

MLA EDGEnetwork® Grazing Land Management course. Contact Pastoral Production Extension Officer DPI&F Katherine, Ph: (08) 8973 9763.

**Further information**


**Related topics**

Biodiversity Conservation, Fire Management, Native Pasture Land Condition, Rangeland Monitoring, Tree Clearing.
Hay: Buying and Producing

Arthur Cameron, David Ffoulkes and Phil Hausler, DoR Darwin

Hay can be purchased or produced for several reasons:

• feeding weaners and poddy calves
• feeding cattle in holding yards
• drought feeding
• backgrounding sale cattle
• feeding horses.

Producers need to select the type of hay that will suit their particular need as well as consider other factors associated with purchasing hay. These include the cost of transport, handling, storage and potential to introduce weeds.

Buying hay

Some hay producers in the Top End have used a locally-developed Voluntary Vendor Declaration form to provide buyers with a formal description of the hay for sale. All buyers can use this information when purchasing hay, particularly buyers implementing a quality assurance program such as Cattlecare®.

The Voluntary Vendor Declaration form:

• is voluntarily supplied by a grower to a prospective buyer
• contains information describing the hay offered for sale including where and when it was produced
• provides information about weed management practices used
• gives details of chemicals applied to the crop during the season.

Quality

If, as a hay purchaser, you are concerned about the quality of hay, a paddock inspection before the hay is baled is recommended, to look for weeds present. Weeds to avoid include the broadleaves Hyptis, Senna, Sida and Crotalaria species, grader grass (*Themeda quadrivalvis*) and mission grasses (*Pennisetum* species).

The best way to assess hay quality is through a feed test performed by an independent registered feed testing agency (e.g. Feed Test Australia). Ask potential suppliers for a copy of the results from feed-tested hay. If they haven’t tested the hay, request a sample for sending away and testing. Testing is worthwhile because it will allow you to judge the quality of the hay and hence the type of stock it can be fed to for the best results.

The Australian Fodder Industry Association (AFIA) has adopted national grades for legume, pasture and cereal hays and silages (see Tables 1 and 2). The grades relate fodder quality to livestock performance where the best quality is A1.

The main indicators used to grade hay are dry matter digestibility (DMD percentage), metabolisable energy (ME, MJ/kg DM) and crude protein (CP percentage). Energy and protein are the main requirements for animal production. Digestibility is a measure of the availability of these in hay or silage. Young growing animals and breeders with calves at foot require the best quality feeds (e.g. pasture/legume hays B2, B1, A2, A1) whereas the lower grades, such as cereal hays <C3, will provide cattle held in yards with minimum requirements for maintaining body weight.
SUMMARY OF BEST PRACTICE

- Do not cut wet season hay crops until after Easter.
- Have hay tested for quality.
- Grow Jarra finger grass for a grass hay crop.
- Grow Cavalcade for a legume hay crop.

**Top End Region hay**

A number of pasture, forage legumes and grass cultivars are grown for hay in the region. Hay is mostly grown during the wet season but there are some irrigated crops, for example Finecut Rhodes grass and forage sorghum. Several types of bales are produced: small square, round (various sizes) and large square (various sizes). Weights range from 15 kg for poorly-made small square bales to 700 kg for some of the large squares. Hay is generally not cut until after Easter, as it often rains when the moon is full over the Easter period.

**Transport efficiency**

With the vast distances hay has to be transported to stations in the Northern Territory, freight cost is critical in assessing hay purchases. For example, loosely-baled round bales may only load 9–12 tonnes (t) per trailer, whereas large square bales may load 18–22 t per trailer, effectively halving the freight cost. The receivers’ ability to handle the product and loading efficiencies will be important factors in the decision making process. Hay should be purchased on a per tonne basis rather than per bale, where possible. Weights in bales can vary by up to or over 100% (150 to 300 kg for round bales, 300 to 700 kg for large, square bales).

**Legume hay**

Legume hay is generally higher in protein than grasses. The crude protein of Top End legume hay is typically 9–14%. The main legume hay cultivar is Cavalcade centro. Hay has been made from a range of other legumes including Verano, lablab and cowpea. The yield expected from a well-grown legume hay crop is 6–10 t/ha.

**Grass hay**

The crude protein of grass hay ranges from 4–12%, depending on the amount and timing of applied nitrogen (and/or the residual nitrogen in the soil from a previous legume crop). The main grass hay crop is Jarra finger grass. Hay is also made from Finecut Rhodes grass, sabi grass, pangola grass, forage sorghums and pearl millet. The yield expected from a well-grown grass hay crop is 10–12 t/ha.

**Native grass hay**

The quality of native grass hay is generally low with crude protein ranges from 2–4%. In the Top End native grass is only used as horticultural mulch.

**Silage**

Good quality silage can be made from irrigated maize or forage sorghum crops.

| AFIA grades for legume and pasture hay and silage |
|-----------------------------------|---------------------|---------------------|---------------------|
| DMD (%) | ME (Mj/kg DM) | CP (%) |
| > 66 | > 9.5 | A1 |
| 60–66 | 8.7–9.5 | B1 |
| 53–59 | 7.4–8.4 | C1 |
| < 53 | < 7.4 | D1 |

| AFIA grades for cereal hay and silage |
|-----------------------------------|---------------------|---------------------|
| DMD (%) | ME (Mj/kg DM) | CP (%) |
| > 66 | > 9.5 | A1 |
| 60–66 | 8.7–9.5 | B1 |
| 53–59 | 7.4–8.4 | C1 |
| < 53 | < 7.4 | D1 |

Tables 1 and 2: Australian Fodder Industry Association (AFIA) grades for fodder. Adapted from www.afia.org.au/quality/national_grades/
Sources
Haydn Sale, HC Sale PL, Hay producer.
Northern Territory Farmers Association
http://ntfarmers.com/

Further information
Australian Fodder Industry Association, Fodder Vendor Declaration Form.
DLRM - Weeds and legislation.

Related topics
Introduced Pastures for the Top End, Weed Management.
Weed Management

Claire Brown, DNRETAS Katherine and Arthur Cameron, DoR Darwin

Weeds consistently rate as one of the greatest threats to the land resource across the Northern Territory. Weed control and loss of productivity cost the NT more than $13 million a year.

Weeds compete with pastures resulting in:

- decreased animal production
- altered fire regimes
- altered run-off and stream flow processes
- restricted access
- injury and/or toxicity to animals or humans
- reduced biodiversity of native grasslands
- increased production costs, including mustering costs.

Characteristics of weeds

- competitive
- produce large quantities of seed
- have excellent seed dispersal abilities
- develop long-term seed banks
- often unpalatable or poisonous to stock.

High priority weeds in the Top End region

Existing weed threats

- Mimosa (Mimosa pigra)
- Sida (Sida spp)
- Bellyache Bush (Jatropha gossypifolia)
- Hyptis (Hyptis suaveolens)
- Senna (Senna obtisifolia)
- Gamba grass (Andropogon gayanus)
- Rats tail grasses (Sporobolus spp)
- Mission grass (Pennisetum polystachion)
- Annual mission grass (Pennisetum pedicellatum)
- Parkinsonia (Parkinsonia aculeata) (in certain catchments)
- Rubber bush (Calotropis procera)
- Crotoloria (Crotoloria goreensis)

Future weed threats

- Parthenium (Parthenium hysterophorus)
- Rubbervine (Cryptostegia grandiflora)
- Pond apple (Annona glabra)
**Management and control of weeds**

Weed management requires integrated weed management practices:

- Clean all vehicles and equipment before entering clean areas or leaving weed-infested areas.
- Restrict service vehicles from travelling throughout properties.
- Learn to identify priority weeds.
- Ensure all property personnel can recognise priority weeds and are vigilant.
- Learn to operate weed control equipment and follow manufacturers’ instructions when using herbicides.
- Carry weed control equipment in your vehicle, and DON’T drive past a lone weed. Destroy it there and then.

**Table 1. Methods used to control weeds**

<table>
<thead>
<tr>
<th>Control method</th>
<th>Examples include:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>Hand pulling, grubbing, slashing. Cultivation, chaining, felling, mowing and targeted grazing.</td>
</tr>
<tr>
<td>Land management</td>
<td>Reduce grazing intensity, revegetation, quarantine, fire, hygiene, report weeds, control feral animals and manipulate environmental stress factors.</td>
</tr>
<tr>
<td>Chemical</td>
<td>Foliar spraying, rope wick applicators, basal bark application, cut stump, stem injection and soil application.</td>
</tr>
<tr>
<td>Biological</td>
<td>Importation, rearing and release of host-specific natural enemies.</td>
</tr>
</tbody>
</table>

**SUMMARY OF BEST PRACTICE**

- Prevention is the key, monitor to prevent the entry of new weeds.
- Prevent seeding.
- Develop an integrated property weed management plan that incorporates a combination of control methods to combat existing weed incursions.
- Purchase clean hay with voluntary hay vendor declarations.
- Purchase only weed free seed for sowing pastures.
- Only feed out hay in areas that can be readily monitored and are away from watercourses.
- Quarantine new stock in a designated holding paddock to enable early detection of weed introductions.
- Incorporate a program of monitoring clean areas into normal station operations.

Note: Allowing weeds to set seed ensures an ongoing long term weed nuisance, an increasing management response and an increasing cost of control.

A package of best weed management practices should include a combination of control methods such as those shown in Table 1.

**Source**


**Further information**

DLRM Weed Management Branch, Goyder Building, Palmerston NT. Ph: (08) 8999 4567.


**Related topics**

Biodiversity Conservation, Fire Management, Native Pasture Land Condition, Poisonous Plants, Tree Clearing.
Cropping
Phil Hausler and Arthur Cameron, DoR Darwin

Dryland cropping can be used to diversify production on cattle properties in the Top End.

Dryland cropping in the Top End is limited to several adapted crops, which include the cereals sorghum and maize, the legumes peanuts and mung beans and the oilseed sesame. The Douglas Daly District of the Top End has been one of the main growing areas for these crops.

Grain sorghum is the main crop grown. It is reasonably tolerant to the extended wet and dry periods experienced during Top End wet seasons. The grain and stubble are extremely useful for cattle fed. Although grain yields of 4.5 to 5.0 tonnes/ha have been achieved in small areas for grain sorghum, 2.5 to 3.5 tonnes/ha are more realistic commercial yields. Live weight gains up to 1 kg/head/day have been recorded for cattle on sorghum stubble for 6 to 8 weeks early in the dry season.

Sowing Time
Mid to late December is the optimum sowing time with early January being reasonable. Crops sown after the first week of January are likely to experience moisture stress towards the end of the season and significant yield loss.

Soils and Land Preparation
Most crop production has been on the red earth soils, which vary from clay loams to loamy sands. The soils are well drained, highly weathered with a neutral pH (6.5–7.0). Common problems experienced on these soils include erosion, soil surface crusting and high surface temperatures at establishment. The clay loams will compact under conventional tillage systems.

Conservation tillage systems are recommended for dryland crop production in the Northern Territory. With these systems, mulch from the previous year’s crop, from pastures or from grass weeds is retained on the soil surface and the crop is sown directly into the mulch after fresh growth is sprayed with a knockdown herbicide.

Fertiliser
A soil test will assist in determining nutrient requirements. The most commonly cropped soils are inherently low in phosphorus, sulphur, nitrogen and some trace elements. Potassium is generally deficient in sandy soils. The quantity and type of fertiliser required will depend on the cropping history. Higher responses are achieved if phosphorus and nitrogen are banded under the seed. Phosphorus, sulphur, zinc and copper can be applied prior to sowing. Nitrogen and potassium should be applied immediately prior to sowing or at sowing. Best results are obtained by topdressing part of the nitrogen three to four weeks after sowing.

A dryland grain crop requires approximately 17 kg of nitrogen to produce one tonne of grain. Where sorghum is sown into a pasture legume ley, the amount of nitrogen applied to the crop may be reduced, because of a contribution of nitrogen by the legume pasture. Sorghum grown at Douglas Daly Research Farm following a 2-year-old Cavalcade ley showed no significant response to applied nitrogen.
SUMMARY OF BEST PRACTICE

• Use adapted crops and cultivars.
• Sow at the correct time.
• Use conservation tillage.
• Apply appropriate fertilisers in adequate amounts at the right time.

Sources

Further information
The main greenhouse gases are carbon dioxide, methane and nitrous oxide, all of which act as a blanket around the earth preventing heat from escaping. In the Northern Territory, 14% of the greenhouse gases are methane emissions from cattle, and 36% is carbon dioxide from bushfires. A further 4% of NT emissions are from agricultural soils and 2% from land clearing. The level of emissions from these sources are not growing over time compared with other sectors such as energy generation and transport.

**Rainfall and temperature changes in the Top End region**

Over most of the Top End region, rainfall has been increasing in recent decades especially the last 15 years. Current opinion is that this extra rainfall may be the result of South-East Asian pollution forcing the monsoon south, rather than global climate change.

Climate predictions for the Top End are not very conclusive. The predictions for temperature are more reliable than for rainfall. Temperature is highly likely to increase, while rainfall is more problematic. The current expectation is for a gradual increase in temperature with rainfall staying about the same. Climate models do not predict this region well, so their results show considerable variation. Even if the region continues to receive similar rainfall, the amount of water available for plant growth may decrease because evaporation is expected to increase. Changes in rainfall for the Top End are likely to be less than for most other parts of Australia.

The other likely changes are that the frequency and severity of extreme events (droughts and cyclones) which are expected to increase and sea levels which are predicted to rise and inundate coastal floodplains.

**Possible vegetation changes**

Increased carbon dioxide levels will likely affect, and perhaps are already affecting, the balance between plant species. The most notable effect may be an increase in woody species. Higher CO₂ in the atmosphere will increase pasture growth but quality will decline as there will be dilution of nitrogen in the plant.

**Costs and opportunities**

According to ABARE (2007), by 2030 climate change could reduce the productivity of the NT pastoral industry by 20%. However, the issue of climate change is too new to be able to predict its long term effect on cattle businesses in the Top End region, but it is likely that indirect factors will have an impact, irrespective of any direct climate effects on regional production.
For example:

• Climate change is predicted to have more effect on rainfall in southern Australia than in the north, so the Top End region may become even more attractive to interstate investors.
• The effect on our competitors and markets is not yet clear.
• There may be local opportunities from carbon offset schemes.
• Measures to reduce agriculture’s contribution to greenhouse gases may result in extra costs.
• There may be changes to land management practices, from reducing fires to encouraging woodland.
• Fuel costs are expected to continue to increase, affecting all aspects of production.
• Increased costs of grain and fuel may affect interstate and overseas feedlot industries which would affect all cattle markets.

Carbon offsets

There is a rapidly developing voluntary carbon offsets market. This may present a future opportunity for producers to offset cattle emissions backed by the Australian Government’s carbon farming Initiative to help farmers access domestic voluntary and international carbon markets. At the moment, only reforestation assets can be traded in a future National Emissions Trading Scheme. However, there is considerable risk to producers if they become involved in carbon offsetting and lose sequestered carbon through fire or drought. They may be liable to pay for lost sequestered carbon.

SUMMARY OF BEST PRACTICE

• Expect some climatic change, understanding that current models are not yet able to predict the effect of climate change for the Top End region with any certainty; however, temperatures are highly likely to increase while effects on total rainfall may well be slight.
• Expect the frequency and severity of droughts, cyclones and floods to increase and sea levels to rise.
• Treat carbon offset schemes with caution and use the Australian Government’s Carbon Farming Initiative for guidance.
• Understand that irrespective of the direct effects of climate change on levels of production, the cattle industry is likely to be affected by economic and legislative changes in relation to a future carbon tax and/or emissions trading scheme.
• Be prepared for change by implementing an adaptive management approach that is sensitive to variations in climate and external market forces.

Sources

ABARE (2007). Climate Change: Impacts on Agriculture. Australian Commodities 07.4
Australian Government Department of Climate Change and Energy Efficiency.
The Cooperative Research Centre for Greenhouse Gas Technologies.
Chapter Three: Cattle Breeding
Chapter Three: Cattle Breeding

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Cattle and land management best practices in the Top End region 2011

Chapter Three: Cattle Breeding

Cattle Maturity Types

Neil MacDonald, DoR Katherine

The maturity type of cattle refers to how early they put on fat. This has implications for both the breeding and finishing phases of production.

Cattle breeds are often classified as early, medium and late maturing, but there is also considerable variation within breeds.

**Early**

Angus, Wagyu, Shorthorn (most British breeds)

- smaller breeds
- put on fat more easily at a lighter weight
- meat is more likely to marble
- fertile because fat/condition is related to fertility
- stand up to dry conditions well because they have a lower maintenance requirement
- good eating quality for Western consumer tastes
- earlier sexual maturity so heifers conceive their first calf at a lower body weight.

**Medium**

Brahman, Droughtmaster, Tuli, Belmont Red, Santa Gertrudis

These breeds have characteristics that are midway between early and late maturing cattle breeds.

**Late**

Large European breeds such as Charolais, Simmental, Blonde d’ Aquitaine, Limousin

- larger, leaner breeds
- condition and fertility of cows will decline if stocking rates are not adjusted to take into account the higher feed consumption (maintenance requirements) of larger breeders
- often favoured by feedlotters because they can get a bigger carcass before it becomes over-fat; reducing trading costs and feed costs
- good eating quality for Asian consumer tastes for lean meat
- meat cuts may be too large (portion size).

Maturity type is based on the mature weight of a breed, calculated from the weight of a breeder at a set level of fat cover.

The major implications for Top End region pastoralists is that understanding the maturity type is the most important decision when considering breeds either as purebred or as components of a crossbred. Since maturity type has profound effects on both fertility and market suitability the choice of maturity type is likely to be more important than the breed itself.
There have been signals from South-East Asian feedlotters that over-fatness is becoming a problem in Brahman feeder cattle exported from the NT. South-East Asian clients receiving our live export cattle may eventually consider late maturing breeds to be more suitable for their feedlotting operations. This demand can be met by crossbreeding with larger mature sized cattle; however the larger breeders that result may have management implications in the Top End region.

Crossbreeding research is being conducted by DPI&F to produce animals that will be late enough maturing to give a big lean carcass in Asia while their mothers still maintain the fertility and survival traits of the Brahman cattle in the region. This research suggests that stations could produce late maturing progeny equivalent to a quarter Charolais without adversely affecting their productivity.

Sources


Further information

Related topics
Bull Selection, Crossbreeding, Production Parameters.
Crossbreeding

Neil MacDonald, DoR Katherine

Crossbreeding can be defined as ‘mating different breeds’. There are two reasons for mating different breeds of cattle:

• making a blend of desirable characteristics from two or more breeds that complement each other
• obtaining benefits from the heterosis (also known as hybrid vigour) occurring in crossbred cattle.

The first generation of crossbred cattle (F1) often outperform their parents in productive traits such as breeder fertility and steer growth rates.

There are numerous beef cattle breeds in Australia. To simplify the discussion on crossbreeding, these can be categorised into five groups:

• Asian Bos indicus (Brahman, Sahiwal)
• African Bos indicus (Boran)
• British Bos taurus (Hereford, Shorthorn, Angus, Devon)
• European Bos taurus (Charolais, Limousin, Simmental, Salers)
• African Bos taurus (Africander, Tuli)

The tropical adaptation, potential fertility and potential growth rate of the five breed groups relative to each other are listed in Table 1. These rankings are a general guide only and variation within breeds results in considerable overlap between breed groups for most traits.

The skill in crossbreeding is to optimise desirable characteristics and minimise the undesirable.

Larger changes can be made in a single generation by crossbreeding rather than selecting from within a pure breed. The pros and cons of different breeds must be considered carefully when planning to use complementary breeds to ensure their progeny meet expectations in the desired traits and do not cause problems in other areas. Retaining sufficient adaptation to the environment in which the crossbred cattle are expected to perform is an essential aspect of crossbreeding. Retaining sufficient adaptation is critical in hotter and more humid areas where external parasites such as cattle tick and buffalo fly present significant challenges to cattle.

The greatest benefits of hybrid vigour from crossbreeding come from the first cross (F1) generation (Table 2). The strategies for breeding after the first cross are more complex.

There are four structured crossbreeding program options available after breeding the F1:

• grading up
• forming a stabilised composite breed
• using a terminal sire
• rotational crossing.

Grading up and forming a stabilised composite breed result in a return to purebreeding in the medium to long term, while using a terminal sire and rotational crossing continue crossbreeding.
**Grading up**

Grading up (or top-crossing) means using the same sire breed each generation and purebreeding in the medium to long term. This system requires the least management input, but results in loss of hybrid vigour with each generation. Compared with straight breeding, grading up may require extra management input on extensive stations to control other bulls and ensure calves are actually sired by the new bull breed.

**Forming a stabilised composite breed**

Forming a stabilised composite (or synthetic) breed involves crossbreeding initially, then closing the crossbred herd at some point and selecting breeding stock from within the herd to form a stabilised new breed over several generations. Composite breeds may be formed from two or more breeds. The herd may be closed immediately after the F1 generation or after later generations, depending on the number of breeds included and desired proportions of each parent breed in the new composite breed. Stabilised composite breeds have the advantage of retaining a proportion of hybrid vigour in a purebred animal. The amount of hybrid vigour is dependent on the number of parent breeds used to develop the composite. Once stabilised, the breeding program returns to purebreeding and requires less management input. The Braford and Droughtmaster breeds are Australian examples of two-breed composites. Making a new stabilised composite is a major operation that requires many thousands of breeders and extensive selection over subsequent generations, making it a task that can not be carried out by a small business alone.

**Table 1.** The relative tropical adaptation, potential fertility and potential growth rate of breed groups

<table>
<thead>
<tr>
<th>Breed group</th>
<th>Tropical adaptation</th>
<th>Potential fertility</th>
<th>Potential growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian <em>Bos indicus</em></td>
<td>Very high</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>African <em>Bos indicus</em></td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>British <em>Bos taurus</em></td>
<td>Low</td>
<td>Very high</td>
<td>High</td>
</tr>
<tr>
<td>European <em>Bos taurus</em></td>
<td>Very low</td>
<td>High</td>
<td>Very high</td>
</tr>
<tr>
<td>African <em>Bos taurus</em></td>
<td>Medium</td>
<td>Very high</td>
<td>Low to medium</td>
</tr>
</tbody>
</table>

**Table 2.** Maximum heterosis (hybrid vigour) retained in each cross-breeding system

<table>
<thead>
<tr>
<th>Mating system</th>
<th>Maximum heterosis (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading up</td>
<td>generation 1 100</td>
</tr>
<tr>
<td></td>
<td>generation 2 50</td>
</tr>
<tr>
<td></td>
<td>generation 3 25</td>
</tr>
<tr>
<td></td>
<td>generation 4 12</td>
</tr>
<tr>
<td></td>
<td>generation 5 6</td>
</tr>
<tr>
<td>Composite</td>
<td>2 breed 50</td>
</tr>
<tr>
<td></td>
<td>3 breed 67</td>
</tr>
<tr>
<td></td>
<td>4 breed 75</td>
</tr>
<tr>
<td></td>
<td>5 breed 80</td>
</tr>
<tr>
<td></td>
<td>6 breed 83</td>
</tr>
<tr>
<td>Terminal sire</td>
<td>2 breed 100</td>
</tr>
<tr>
<td>Rotational crossing (2 breed)</td>
<td>generation 1 100</td>
</tr>
<tr>
<td></td>
<td>generation 2 50</td>
</tr>
<tr>
<td></td>
<td>generation 3 75</td>
</tr>
<tr>
<td></td>
<td>≥ generation 7 67</td>
</tr>
</tbody>
</table>

Note: Heterosis is determined by number of parent breeds, and proportions of parent breeds.
**Using a terminal sire**

Using a terminal sire means no male or female progeny are retained. Cows are mated to bulls of a different breed with superior growth and carcase attributes and all progeny are marketed. Terminal sires can be used over a proportion of a purebred or crossbred herd to improve the value of sale or slaughter progeny. An example applicable to some areas of northern Australia is using Santa Gertrudis x Charolais bulls over a portion of a high-grade Brahman cow herd and marketing all progeny. Use of terminal sires over the whole herd is not practical in the Top End region because the purchase of replacement breeders is not a viable option.

**Rotational crossing**

Rotational crossing, also known as criss-crossing, involves the use of two or more breeds. Two-breed rotational crossing involves mating cows to the bull breed that was not their sire. The system requires greater management input than grading up or using a composite breed because breeder groups are segregated and bulls mated accordingly. However, a greater proportion of hybrid vigour is retained. Bull control to ensure the right bulls are mated to the right cows is a big issue, especially in smaller herds. In extensive areas, producers attempting rotational crossing should expect and accept some progeny will result from unintended matings.

**Sources**

Neil MacDonald, DPI&F Katherine Ph: (08) 8973 9746.

Phillips, A (2001). *Beef Cattle Genetics applied to Extensive Herds*, DPIFM and MLA.

**Further information**


**Related topics**

Bull Selection, Cattle Maturity Types.
Chapter Three: Cattle Breeding

Mating Systems
Trudi Oxley, DoR Katherine

Timing and distribution of calving are two significant factors that influence average weaner weight and kg's weaned. Increasing the proportion of breeders calving in the favourable time of year will increase profitability of a herd. Different mating systems direct different levels of emphasis towards the timing of calving. Each mating strategy needs to be carefully considered for their practicality in being able to achieve the desired level of cattle control.

Continuous mating
Continuous mating is common in northern Australian beef herds. Bulls are run with cows continuously and calves are born throughout the year. In the Top End region, 65% of producers continuously mate all breeders (Darwin Pastoral Industry Survey, 2004).

Benefits
- If a cow aborts a calf or her calf dies, she can potentially get pregnant again much sooner.
- It requires little effort to manage bulls and maintaining paddock security is not so critical.
- It requires a lower level of management.

Disadvantages
- Calves born late in the wet season or early dry season do not reach suitable liveweight for weaning until late in the year. Low liveweight and poor feed conditions make management of these second round weaners for subsequent turn-off or breeding more difficult.
- Increased costs associated with preventing mortality of lactating breeders throughout the dry season.

Seasonal mating
Seasonal mating, sometimes referred to as controlled mating, influences the timing of when calves are born. The major objective is to time mating to match the increase in feed quality—because nutritional requirements peak during early lactation. In the tropics, the main aim of seasonal mating is to prevent dry season lactation.

Time of calving needs to be planned to synchronise the nutritional demands of breeders with the nutritional quality of the pasture. The nutritional demands of breeders are high while lactating, peaking shortly after calving. Therefore, the optimum time of calving is generally October to December for much of the Top End region.

According to the Darwin Pastoral Industry Survey (2004), pastoralists used an average joining season of 4.6 months. This is in line with recommendations from other areas of northern Australia which have found a five month period to be a 'safe' compromise to achieve the benefits of seasonal mating, and prevent a drop in weaning rates as calving patterns change. It is also a practical approach which allows the bulls to be distributed before it becomes too wet to move about and allows them to be removed at first round saving the need for a special muster.

In situations where seasonal mating is too difficult to carry out over the whole herd, targeting resources to seasonally mate heifers is a useful strategy which gives the breeder herd the best possible chance of at least starting in an optimum calving pattern.
**SUMMARY OF BEST PRACTICE**

- Develop a good heifer replacement program and aim to have them mated at the correct time first up.
- Implement seasonal mating.
- Physically relocate breeder bulls well away from breeder paddocks in the non-mating period.
- Strategically locate bulls in holding paddocks before the onset of the wet season to enable their introduction into the herd during the wet season with a minimum of fuss.
- Consider physical removal, by catcher or euthanasia, of non-musterable bulls in breeder paddocks.
- Take advantage of having bulls separated by fertility testing and vaccinating before re-introduction to the breeder herd.
- Keeping the average age of bulls down and making sure they are well handled and educated will help.
- As a first step implement seasonal mating with first calf heifers.

## Benefits

- Minimising dry season lactation and the associated supplement costs.
- Better able to produce a more even line of cattle which enhances marketing and cash flow predictions.
- Benefits in terms of stocking rate if the second-round weaners do not have to be held over for an extra year before they meet market requirements.
- Potential cost savings associated with the ability to reduce or avoid the second-round muster, with consequent labour savings and reduced incidence of mismothering causing death of calves.
- Reduced mortality of weaners' mothers in the late dry season.
- Better bull control which reduces the spread of venereal diseases.

## Disadvantages

- By eliminating a second round of mustering all calves would potentially have to be branded as a weaner the following year.
- Total bull control can be problematic in the Top End region on larger properties due to flood fences being washed down, the presence of scrub bulls and bulls being left behind when mustered with helicopters.
- Seasonal conditions may cause large numbers of cows to ‘slip’ from the optimum calving cycle and miss joining if the joining interval is short (less than three months). A five month joining period can help to overcome this problem.
- Changing from continuous to seasonal mating may have a short-term decrease of calving percentage (one to two years).
- Need 100% musters to remove bulls to make it work.

## Breeder herd segregation through pregnancy testing

In areas where bull control is difficult a useful strategy to achieve some of the benefits of seasonal mating can be to segregate breeders according to pregnancy status, if a cow falls out of the optimum calving pattern, foetal aging allows her to be segregated in another herd which receives different management, or to be culled and replaced with a breeder that will calve at the optimum time.

### Benefits

- Enhancing herd fertility by culling sub-fertile and lower gross margin groups of breeders (i.e. those who will be lactating throughout the dry season).
- Better use of supplements which can be targeted to groups which have most need and where responses will be best, e.g. first calf heifers.

### Disadvantages

- The need for pregnancy diagnosis to determine status.
- Additional management to undertake and monitor putting the practice in place.
- Problems with cows being moved around the property, often they return to their ‘home range’.

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**Sources**


**Further information**


**Related topics**

Breeding Polled Cattle

Sarah Streeter, DoR Katherine

Horned cattle cause significant losses through bruising during transport, and at feedlots and abattoirs. Carcass damage from horns is estimated to cost the beef industry $22.5 million per year.

While dehorning has been standard practice to eliminate the risk of bruising and danger to handlers, there are predictions of increased pressure, from a welfare perspective, to find alternatives. Breeding polled cattle is one alternative.

Breeding polled cattle is a cost-effective alternative to dehorning and has a number of advantages in avoiding particular risks or costs such as:

• labour associated with dehorning
• infection of wound sites
• reduced growth rates while wounds are healing
• negative perception of the beef industry.

Horns, scurs and polled

It is important to establish a clear classification of horns, scurs and polled. In horned cattle (Figure 1), the bony material is fused to the skull and grows as an extension of the skull. As young calves, the small horn is free floating, but attaches by about two months of age. Scurs are defined as bony tissue which are usually loosely attached and moveable (Figure 2). For management purposes, scurs generally do not need to be removed, as they do not pose the same risks as horns. However, some producers will remove the tissue in young animals if unsure whether the animal is scurred or horned.

A ‘true’ or ‘clean’ polled animal (Figure 3) is without any bony tissue where a horn would normally grow and will often have a prominent bony feature on the top of the head, referred to as the ‘poll’. Scurred animals may also have a defined poll.

Figure 1. Dehorned

Figure 2. Scurred

Figure 3. Polled
Inheritance of horns

Bos taurus breeds

The genes which control the horn and poll trait in British and European breeds follow a simple mode of inheritance. There are two forms (alleles) of the gene – polled (P) and horned (p). An animal will always have two copies of every gene, one inherited from each parent. In this case, the polled gene is dominant over the horned gene. That is, the polled gene overrides the horned gene if both are present:

- Polled cattle can have either two copies of the polled gene (PP), or one copy of each (Pp), where P overrides p to result in a polled animal.
- Horned cattle can only have two copies of the horned gene (pp) (Table 1).

When parents pass on a single copy of the gene, it happens randomly, like flipping a coin. So a polled animal which has a gene combination of Pp has a 50% chance of passing on either allele to its offspring.

Table 1. Bos taurus horn/poll gene combinations and horn/poll status of the animal

<table>
<thead>
<tr>
<th>Gene combination</th>
<th>Horn/poll status</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP</td>
<td>Poll (True poll)</td>
</tr>
<tr>
<td>Pp</td>
<td>Poll</td>
</tr>
<tr>
<td>pp</td>
<td>Horned</td>
</tr>
</tbody>
</table>

Outcomes of matings

Selecting all polled bulls to mate to all polled cows will not guarantee 100% polled progeny, as both parents could carry the recessive horn gene (p). If you have a sire that always produces polled progeny, you can be confident that the bull is a true poll and does not carry the horn gene. Using horned animals in a breeding program increases the frequency of the horn gene in the herd, and increases the chance of having progeny with two copies of the horn gene and a resulting horn status.

Bos indicus and tropically-adapted breeds

The inheritance of horns is much more complex in tropical breeds. Scientists are still investigating the inheritance patterns of the horn/poll/scur status in tropically-adapted cattle. This description is based on the current knowledge.

As well as having the same gene controlling horns in Bos taurus (P), Bos indicus cattle also have a scur (Sc) and African horn (Ha) gene which control the horn/poll/scur status of the animal, and all three interact together. Both Brahman and adapted composite breeds are mostly influenced by the African horn gene. To complicate the inheritance of the trait further, it is thought that the African horn gene has a masking effect on the polled gene and both the African horn gene and the scur gene are sex-influenced. Sex-influenced in this case means that the horn status will be different for bulls and cows that have the same gene sequence. The methods by which the African horn gene and scur gene are sex-influenced are not yet understood.

Bos indicus cattle will only have the chance of being polled if they have the Bos taurus gene combination for being polled (Pp or PP). The alleles for the African horn and scur gene will then determine the horn status of the animal. If a Bos indicus animal has the Bos taurus gene for being horned (pp), it will be horned regardless of the combination of forms of the other genes. A Pp animal can be horned if it is genetically horned with the African horn gene (HaHa or Haha) (Table 2).

The unfavourable allele (horn) of the African horn gene is represented by Ha, and the favourable allele (poll) is represented by ha. Due to the sex-influenced nature of the gene, a cow which has the African horn genes Haha will be polled, whereas a bull which has the same sequence will be horned. A bull must have the sequence haHa to be polled. Therefore, a clean poll bull (no scur) does not carry the unfavourable African horn allele according to the present understanding of the inheritance.

The scur gene is also sex-influenced, where it is more likely for bulls to be scurred than females. Scurs will only appear in genetically polled animals as they have to appear at the same place as that of horns, that is to say that if an animal is horned it cannot express scurs even it is genetically scurred.

Outcomes of matings

It is far more difficult to breed for polled cattle in tropically-adapted breeds than in Bos taurus breeds, as the number of genetic combinations of matings and progeny is enormous. A clean polled bull (no scur) cannot have the horned allele of the African horn gene (Ha), but he may carry one copy of the horned allele from the Bos taurus gene, which may result in horned progeny if mated with a horned cow or a polled cow that carries a copy of the horned Bos taurus allele.

Producers who breed Brahman or tropically-adapted cattle (e.g. Santa Gertrudis), will notice more horned and scurred bull calves than heifers because the genes are sex-influenced.

With the current degree of knowledge of the inheritance of horns in tropically-adapted cattle, Bos indicus producers would take an estimated 40 years to breed a 100% polled herd, if selecting solely for polled animals. However, with few polled animals in these breeds, a specific polled bull breeding programme cannot be implemented easily. DNA tests are currently being developed by scientists, which aim to give an indication of the genetic potential of an animal to breed polled progeny and accelerate the polled breeding process. When released, the DNA tests could be used in conjunction with the selection for other economic traits to make breeding decisions and increase the frequency of polled animals in the herd.
Table 2. Inheritance of scurred and African horn genes in beef cattle (Georges et al. 1993)

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inheritance of the scurred phenotype</td>
<td></td>
</tr>
<tr>
<td>P/- Sc/Sc</td>
<td>Scurred</td>
<td>Scurred</td>
</tr>
<tr>
<td>P/- Sc/sc</td>
<td>Scurred</td>
<td>Polled</td>
</tr>
<tr>
<td>P/- sc/sc</td>
<td>Polled</td>
<td>Polled</td>
</tr>
<tr>
<td>p/p -/-</td>
<td>Horned</td>
<td>Horned</td>
</tr>
</tbody>
</table>

*Epistatic effect of the African horn gene on the polled locus*

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>P/- Ha/Ha</td>
<td>Horned</td>
<td>Horned</td>
</tr>
<tr>
<td>P/- Ha/ha</td>
<td>Horned</td>
<td>Polled</td>
</tr>
<tr>
<td>P/- ha/ha</td>
<td>Polled</td>
<td>Polled</td>
</tr>
<tr>
<td>p/p -/-</td>
<td>Horned</td>
<td>Horned</td>
</tr>
</tbody>
</table>

**SUMMARY OF BEST PRACTICE**

- Consider selecting for the polled gene to reduce the need for dehorning.
- Appreciate the complexity of breeding polled cattle in Bos indicus herds.

**Sources**


**Further information**

Phillips, A (2001). *Beef Cattle Genetics Applied to Extensive Herds,* NT DPIFM.

**Related topic**

Bull Selection.
Bull Selection

Sarah Streeter, DoR Katherine and Barry Lemcke, DoR Darwin

The selection of bulls is critical to the genetic improvement of the herd. Eighty seven percent of the genetics of a herd is controlled by the last 3 generations of sires. The bull you use today has a heavy influence on the herd productivity for the next 14 years.

Selection criteria will differ according to the environment, management systems and target markets. With so many traits to take into consideration, it is helpful to establish a breeding objective for your operation, and to revise this often.

Breeding objectives

When considering your breeding goals, there are a number of factors to take into consideration:

- customer/market requirements
- traits of economic importance
- current performance levels
- future herd production targets
- heritability of traits and correlation between traits.

Traits requiring emphasis in selection can be identified by comparing current performance levels with future targets and customer/market requirements. Keep all economically important traits in mind, to avoid inadvertently selecting one important trait over another. For example, continued selection for high growth may reduce the fertility of the herd. As with all goals, a breeding objective should be specific, measurable and attainable. Greater progress can be achieved with traits that are more highly heritable i.e. more influenced by genetics and less by environmental factors. Focus on traits of economic importance rather than traits that have more to do with ‘tradition’ or ‘personal preferences’.

Estimated Breeding Values (EBVs)

EBVs are calculated values of an animal’s genetic merit for a particular trait. These values are shown as a + or – for each animal and each trait relative to the base for its breed. This figure also takes into account the heritability of the trait and correlations with other traits. The figures are generated by BREEDPLAN, a beef cattle genetic evaluation system, based in Australia. For example, a bull may have an EBV for 400-day growth of +10 kg. Half of the calf’s genes come from the bull, so without knowing the mother’s EBV you could predict this bull has the genetic potential to produce calves 5 kg heavier at 400 days than a bull with an EBV for 400-day growth of +0 kg.

An accuracy percentage is assigned to each EBV for an animal and indicates the confidence level of the EBV. The accuracy figure is based on the amount of information available on the animal. In addition to sire and dam information, the accuracy value increases as the number of brothers, sisters and progeny with measurements increases (accuracies range from 0–99%). Accuracy should always be taken into account when considering an animal’s EBV.

EBVs mostly cover traits for animal growth, reproduction and carcase characteristics (Table 1). Not all of these traits will be measured on every animal. Animals from extensive areas such as parts of the Top End region are less likely to have the full range of traits recorded. More information should be available for animals in more intensive grazing systems. Some breed societies have developed figures for traits of particular interest. For example, marbling potential is valued highly in Angus cattle, and is heritable, so an EBV has been developed for IMF% (Intramuscular Fat). However, there are very few Brahmans with EBVs for IMF%, as this is not a trait commonly selected for in the Brahman breed.
Table 1. EBV trait list

<table>
<thead>
<tr>
<th>Weight</th>
<th>Carcase</th>
<th>Fertility and other traits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight</td>
<td>Eye muscle area (EMA)</td>
<td>Scrotal size (SS)</td>
</tr>
<tr>
<td>200-day milk</td>
<td>Fat thickness (rib)</td>
<td>Days to calving (DC)</td>
</tr>
<tr>
<td>200-day weight</td>
<td>Fat thickness (rump) (P8 fat)</td>
<td>Gestation length (GL)</td>
</tr>
<tr>
<td>400-day weight</td>
<td>Carcase weight</td>
<td>Calving ease – Direct and maternal</td>
</tr>
<tr>
<td>600-day weight</td>
<td>Retail beef yield (%) (RBY %)</td>
<td>Feed efficiency (NFI)</td>
</tr>
<tr>
<td>Mature cow weight</td>
<td>Intramuscular fat % (IMF%)</td>
<td>Docility</td>
</tr>
</tbody>
</table>

These traits can be used to construct an Index that relates to a particular market according to each trait’s economic significance in that market. Reproduction is much more important economically for the herd productivity than growth or meat quality, in the ratio of 8:2:1.

EBVs are a tool to be used in conjunction with other methods of selection. Visual assessment and Bull Breeding Soundness Evaluation (BBSE) are still important to check that the bull is structurally sound and fertile as well as having genetic potential.

Table 2. Hypothetical bull value calculations

<table>
<thead>
<tr>
<th></th>
<th>Bull 1</th>
<th>Bull 2</th>
<th>Bull 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bull purchase cost ($)</td>
<td>2500</td>
<td>3000</td>
<td>3500</td>
</tr>
<tr>
<td>Transport ($)</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Landed cost ($)</td>
<td>2600</td>
<td>3100</td>
<td>3600</td>
</tr>
<tr>
<td>Bull mortality (%)</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Effective bull cost ($)</td>
<td>2678</td>
<td>3193</td>
<td>3708</td>
</tr>
<tr>
<td>Salvage value of bull ($)</td>
<td>800</td>
<td>800</td>
<td>800</td>
</tr>
<tr>
<td>Net bull cost ($)</td>
<td>1876</td>
<td>2393</td>
<td>2908</td>
</tr>
<tr>
<td>No. mating seasons</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Bull %</td>
<td>4.5</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>No. cows mated to bull/year</td>
<td>22</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Weaning rate (%)</td>
<td>75</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Calves per breeding lifetime</td>
<td>83</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>Average weaning weight (kg)</td>
<td>170</td>
<td>170</td>
<td>180</td>
</tr>
<tr>
<td>Bull cost/calf ($)</td>
<td>22.54</td>
<td>19.14</td>
<td>23.26</td>
</tr>
<tr>
<td>Kg calf weaned in lifetime</td>
<td>14168</td>
<td>21250</td>
<td>22500</td>
</tr>
<tr>
<td>Lifetime value of production from bull* ($)</td>
<td>20789</td>
<td>31607</td>
<td>33092</td>
</tr>
</tbody>
</table>

* based on a $1.60/¢/kg value of progeny at weaning

Table 1 shows that cheaper bulls may not always be the best value in the long run. Bull costs can be reduced by reducing bull percentages as seen in the, or by buying bulls with superior EBVs which result in better lifetime value of production.

Benefits of spending more on bulls

There are some simple calculations to determine the cost-benefit ratio of purchasing higher quality bulls which have been soundness evaluated. By purchasing fertility-tested bulls, bull percentage may be confidently reduced, while genetically superior bulls should produce calves with higher production potential.

Consider the scenarios of purchasing 3 classes of bulls (Table 2):

- Bull 1: Inexpensive, average quality bull with no BBSE
- Bull 2: Average quality bull with BBSE
- Bull 3: Good quality bull with BBSE and 200-day growth EBV of +20 kg
**Homebred bulls**

Breeding bulls ‘on-property’ has both advantages and disadvantages.

**Advantages**

- It is a cost-effective method of attaining high quality genetics, provided the sires are high quality.
- Bulls entering the commercial herd will have been bred in the environment in which they must perform.
- Animals of uniform age under uniform environmental and pasture conditions can be compared and selected.
- If data is collected on the bull breeding herd, superior commercial bulls which fit the operation’s breeding objectives can be selected with confidence.
- Imported bulls can produce poor quality semen for up to 2 years after arriving. This reflects transport stress and/or lack of adaptation to the environment.

**Disadvantages**

- To achieve significant herd improvements, a long-term program must be planned and adhered to.
- A bull breeding herd requires more intensive management and data recording than the average commercial herd in an extensive cattle operation.
- Time and labour requirements are higher for effective implementation of selection practices. Producers may find individual identification and recording tasks onerous.

Whether crossbreeding or straight breeding, greater genetic progress and increased profitability result from improved objectivity and the ability to define the genetic differences of the bulls on offer.

**Expected herd life of a bull**

Bulls should have reached sexual maturity at two years of age. Introducing bulls to a herd as 3-year olds wastes a year of their herd life. If purchasing bulls from outside the region, consider purchasing them as yearlings and putting them in a bull paddock until ready for use. This allows for adaptation to the environment and recovery from any adverse effects of relocation. Bulls should be culled at 8 years of age or earlier.

**SUMMARY OF BEST PRACTICE**

- EBVs can be used as a selection tool to identify superior genetics, but should be used with other tools e.g. visual assessment, BBSE.
- The lifetime production value of a bull can be enhanced by selecting genetically superior bulls that have been soundness evaluated.
- Higher priced bulls with positive EBVs in priority traits may yield a higher value of production in their herd life than cheaper bulls.
- Breeding homebred bulls is a cost-effective way of attaining high quality genetics and ensuring environmental adaptability.
- The expected herd life of a bull is approximately five years, if entering the herd as a two-year old.
- Select bulls from the environment where they are going to be used, or a more severe environment.

**Source**

BREEDPLAN.
http://breedplan.une.edu.au/

**Further information**

MLA EDGENetwork® – The Breeding Edge course.
Contact Pastoral Production Extension Officer, DPI&F Katherine, Ph: (08) 8973 9763.

QLD Department of Primary Industries and Fisheries.

Sundstrom, B (2005). Breedplan and the bull buyer,

**Related topics**

Chapter Three: Cattle Breeding

Bull Breeding

Soundness Evaluation

Gehan Jayawardhana, formerly DPIF Darwin

Reducing bull percentage can only be undertaken with confidence if it can be ensured that the bulls going into the paddock are all able to sire calves. Keeping unproductive bulls is not only inefficient, but can contribute to reduced herd fertility, increases the number of bulls being run and slows genetic improvement.

Bull Breeding Soundness Evaluation (BBSE)

The main method of assessing breeding soundness is to undertake a Bull Breeding Soundness Evaluation (BBSE). It is recommended that the examination is carried out by a veterinarian or a qualified and experienced person. A BBSE is a physical examination of a bull to measure his capability to successfully serve and fertilise the ova in the cow. The process evaluates the bull for a number of important reproductive traits. Critical faults can be picked up in a BBSE that will not be identified on visual appraisal alone e.g. semen quality.

A typical crush-side BBSE in the Top End region will include:

- Examination of testicles (size, tone, symmetry).
- Examination of the penis, prepuce and sheath.
- Collection and evaluation of semen.
- Palpation of internal sex organs.
- Structural soundness of the legs, feet, eyes.

Assessment of libido or serving ability completes a BBSE. While it is desirable to include this test, it is often omitted in extensive systems due to large numbers of bulls to be tested and cost and time constraints. BBSE should be considered if aiming for 3% or lower bull percentages or a narrow conception period.

Important soundness traits

Scrotal conformation and size

Scrotal size is an important trait related to calf-output of the bull, as it is directly related to sperm production capacity. Generally, the minimum size in two year old Bos indicus (Brahman) bulls is 30 cm, and 32 cm in two year old Bos taurus (British and European breeds) bulls. Body condition must be considered, as scrotal size can vary up to 4 cm depending on body condition. When palpated, the testes should have firm resistance to pressure and move freely within the scrotum. Soft testes can indicate degeneration, while overly hard testicles can indicate swelling and infection. Both traits can result in abnormal sperm cell production and the bull should be inspected by a veterinarian.

Figure 1: Minimum scrotal size for two year old Bos taurus and tropical breed bulls in paddock condition.
Limb conformation
Selecting for leg structural soundness is important on large properties in the Top End region, where bulls must be capable of walking long distances. Post-leggedness (overly straight in the hind limbs) should be avoided, as this puts strain on the hips when weight-bearing for service, and may interfere with a bull’s desire to mate. This also predisposes the bull to swollen hocks and arthritis in the hip and stifles joints. Sickle hock (overly angled in the hind limbs) is a less severe fault.

Hoof structure
Hoof structure is as important as limb conformation for bulls to be capable of walking long distances and last for years in the herd. A common fault seen in bulls is too much angle in the pastern joint, or ‘walking down in the pasterns’. The pastern is the joint directly above the hoof. This fault will eventually cause the feet to grow long and the dewclaws to wear down. Conversely, being too straight in the pastern joint will cause the feet to wear down excessively. Overgrown, curve or scissor of the toe claws should be avoided, as this can be an indication of poor limb conformation.

Sheath size, shape and contents
Pendulous and excessive length of the sheath should be avoided. These bulls can be prone to injury and prolapse of the prepuce. The penis should be examined while ejaculating to identify penile faults such as spiral deviation.

Body condition and weight
Prolonged poor nutrition and deteriorated body condition will affect a bull’s capability to produce adequate quality sperm.

Other important traits
Birth weight is the most important trait to select on if dystocia is a problem. Width between the pin bones (the two points slightly below and to the outside of the tail) is important as an ease-of-calving trait for daughters.

If a bull has failed a BBSE?
If bulls are being tested once per year before mating, they should be culled for failing a BBSE. If a highly valuable bull e.g. an expensive stud animal, fails the semen evaluation, consider retesting the bull at a later date particularly if it has been transported recently or may have had an illness. Some conditions, such as three-day sickness and transport stress, can cause temporary fertility problems in bulls. In a commercial situation, bulls should not be given the chance to recover.

Criteria for culling
• Failing a BBSE
• prolapse of the prepuce
• penile abnormalities or injury
• severe foot or limb faults or breakdown
• prolonged deterioration of body condition
• unacceptable temperament.

SUMMARY OF BEST PRACTICE
• Insist on a BBSE on all purchased bulls.
• Annually cull bulls failing a visual assessment of important soundness traits.
• Consider BBSE for testing bull soundness prior to joining – especially in a controlled mating situation.
• Cull commercial bulls that fail a BBSE.

Further information
QLD Department of Primary Industries and Fisheries.

Related topics
Bull Percentages, Bull Selection.
**Bull Percentages**

Jessica Mayes, formerly DPIFM Katherine and Sarah Streeter, DoR Katherine

Bull percentages can be critical to economic outputs of the herd. A low bull percentage, without soundness testing, can lead to reduced weaning percentages and extended calving intervals. A high bull percentage will increase the cost of calf production. Both scenarios can reduce the profitability of a herd.

**Bull Percentages**

Jessica Mayes, formerly DPIFM Katherine and Sarah Streeter, DoR Katherine

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**Bull percentages**

A survey conducted in the Darwin region showed the average bull percentage to be 4%, which is slightly below the NT average of 4.3%.

The only way a producer can confidently reduce bull percentages in an extensive system is to include bull breeding soundness evaluation (BBSE) into the breeding program. The main research into this subject was the ‘Bullpower’ project which was conducted on extensive properties on Cape York in Queensland. The project found a bull percentage of 2% was sufficient when bulls were tested yearly with a BBSE test. DPI&F advises a more conservative 3% with an initial BBSE and an annual visual check. The semen evaluation component of the BBSE is crucial in determining a bull’s calf-getting ability. If bulls are not soundness tested, it is best to allow a margin for sub-fertile bulls.

**Cost per Calf ($)**

A higher purchase price for a better quality bull can be absorbed due to the greater number of calves generally produced by a bull over his lifetime when a lower bull percentage is implemented (See Table 2 in Bull Selection).

**Reducing bull percentage for genetic improvement**

The large numbers of bulls purchased by some enterprises in the Top End could result in a relatively low average quality of sires. By reducing the bull percentage, a buyer can concentrate on purchasing better quality bulls, leading to genetic improvement of the herd. The long-term benefits of improving the quality of genetics entering the herd today should not be underestimated. A bull purchased today will influence the herd through his genetics for the next 14 years.

**SUMMARY OF BEST PRACTICE**

- Bull percentages can be reduced to 3% if bulls are soundness evaluated prior to joining.
- Reducing bull percentages increases genetic gains and profitability provided those bulls have desirable genetics for the herd.

**Sources**

QLD Department of Primary Industries and Fisheries.


**Further information**

MLA EDGENetwork® – The Breeding Edge course.  
Contact Pastoral Production Extension Officer, DPI&F Katherine, Ph: (08) 8973 9763.

**Related topics**

Artificial Insemination

Gehan Jayawardhana, formerly DPIFM Darwin

Artificial Insemination (AI) in the Northern Territory has particular application in the breeding of replacement herd bulls from a select nucleus cowherd on the property. AI is too expensive for breeding steers. An alternative to AI is to run a nucleus herd specifically for breeding bulls.

Artificial insemination

Artificial insemination as a management tool has some major advantages and disadvantages.

Advantages

• facilitates rapid genetic improvement
• allows access to new blood lines
• crossbreeding can occur without capital outlay on new bulls
• allows extensive use of superior sires
• allows access to sires which would otherwise be outside the normal price range of a producer.

Disadvantages

• Conception rates are usually lower than in normal mating situations.
• Good holding paddocks and yards with a race and crush are essential. Holding paddocks should be close to the yards and large enough with sufficient feed to hold the animals.
• Careful planning and organisation of AI programs are essential.
• Resources and effort are required to detect cows on heat, unless a blanket program is used.
• Poor weather conditions during the program can impact badly on conception outcomes.

Bulls

Bulls should be of known superior performance based on superior performance through Breedplan EBVs for weight gain and reproduction. They should be from herds where all empty females are culled as such bulls are more likely to have highly fertile female progeny.

Cows

Cows should be:

• non-pregnant
• in good condition and on a rising plane of nutrition
• fertile
• disease-free
• from a suitable genetic base for herd improvement
• individually identified by ear tags or number brands
• vaccinated for vibriosis and leptospirosis.

Quiet, well-handled cattle are preferred as wear and tear on man and beast are reduced with quiet, tractable cattle. Stressed or excited cattle have reduced conception rates.

At the start of the program a suitably qualified person should check each cow, per rectum, for pregnancy, normal reproductive organs and ovarian activity. Ideally, cows included in an AI program should have regular heat periods when non-pregnant. It is essential that females be in good condition (forward store) and preferably on a rising plane of nutrition if conception rates are to be satisfactory.
The use of non-lactating cows or heifers is recommended in *Bos indicus* cattle because lactational anoestrus can cause reduced conception rates. Heifers are preferable because good cows should always be lactating or pregnant. As a general rule, heat periods are initiated when heifers are 300 kg body weight. Do not use females for AI if they are empty after exposure to a bull, unless they were lactating. If a bull cannot get a non-lactating female pregnant naturally, there is usually something wrong and she should be culled. The cows should be identified and selected a year before the program starts to allow appropriate management to be implemented. Heifers and skinny cows that have had weaners removed can be kept away from bulls so as to be in good condition for AI. Maiden heifers should be handled well and worked through the yards prior to the start of the program to reduce stress.

**Facilities**

Prior to any program commencing, equipment and facilities must be of a satisfactory standard. Ensure yards, crush, shade cover, water supply at yards and a holding paddock (containing sufficient feed) are prepared well in advance.

**AI Program requirements**

Specific equipment required is:

- AI kit box
- Semen storage tank and liquid nitrogen
- Box of 100 heat mount detectors
- Chinball harness and paint
- Drugs for synchronisation
- Semen straws.

Labour of two people is required for the duration of program.

Sheaths, pistolettes, gloves, scissors, tweezers, liquid nitrogen and cylinders can be prepared and/or purchased at the same time as the semen is ordered.

**Detection of oestrus and conception rates**

Successful artificial insemination depends on whether the inseminator can determine if a cow is on heat. Heat detection is essential to determine the time of ovulation. In *Bos indicus*, best results are achieved if insemination occurs at the time of heat detection where as in *Bos taurus* breeds, best results are achieved if insemination occurs at 12 hours after first detection of heat. Observation is best undertaken in the early morning and late evening. Teaser steers or penis-deviated bulls with paint-marking chin-ball harnesses, tail paint or heat-mount detectors can be used to aid detection. Blanket AI (also known as fixed time AI) is done with no heat detection. Females are inseminated 48 hours after implant removal. These programs have lower labour costs but also lower conception rates.

Generally, for *Bos indicus* cattle in the Northern Territory, a single insemination delivered by an experienced inseminator under good to ideal conditions can yield the following conception rates:

- 40% (blanket)
- 50% (synchronisation and heat detection)
- 60% (natural heats and detection)

Less experienced inseminators, poor technique and other environmental factors can greatly reduce conception rates.

**Records**

Good record keeping is vital. A dedicated AI book should be ruled up and contain information about infections, weight, condition, lactational state, details on oestrus cycle and any other relevant comments. These can be transferred to a computer.

Well-maintained records may provide the information required to explain phenomena such as poor conception rates. Good records also aid in the identification of poor breeders. The inseminator can analyse the data and this may assist in planning future programs.

**Training**

In the Northern Territory, the Charles Darwin University offers training in AI. Contact the course coordinator at the Katherine campus.
Mothering Up
Trudi Oxley, DoR Katherine

Mis-mothering that occurs through handling can be a significant contributor to calf loss. This can largely be avoided. Mis-mothering can occur in a number of situations such as being left behind during the mustering process, in the yards, being separated from mothers on the way back to their home paddock and from first calf heifers walking away from their calves. It is important to be aware that cows don’t necessarily automatically mother up and that staff might not understand this.

Symptoms and consequences of mis-mothering

Symptoms include calves alone at troughs drinking, standing in the same spot on their own for extended periods of time, hollowness and sunken eyes and erratic behaviour by mothers, especially heifers.

Whilst it may be convenient in the short-term to save time by allowing mis-mothering to occur, producers may be better off financially to adopt mustering and herd management strategies that may minimise mis-mothering losses.

Mis-mothering losses could decrease the weaning rate by 1–3%. For a 4000 cow breeding herd this is 40–120 calves. Apart from it being an animal welfare issue, the losses from mis-mothering also include the cost of raising poddy calves, foregone income from future sales and having less replacement breeders.

To aid mothering up

• Do not muster at peak calving times – leave freshly calved cows behind. The calves are too young to brand.
• Leave cattle in yards for a minimum amount of time, but avoid rushing them through.
• Do not draft mobs with lots of baby calves into other paddocks, because a calf will go back to where it had its last suck if it is separated from its mother.
• Never let cows run back to the paddock without holding the lead up, always steady them out of the yards and settle them before walking.
• Hold cattle up in holding paddocks (overnight) before letting them go back into the paddock to allow time to mother up, or hold cattle around a water point until mothered up. Many cows will need to be tailed long enough to have time to have a feed before collecting their calf.
• Minimise disturbances to a cow and newly born calf (the first 24 hours.)
• Heat at the end of the year seems to escalate the problem. Minimise the effects of hot weather on baby calves by handling early in the day or late afternoon.
• When walking cows and calves don’t pressure the tail too much. Allow the mothers to come back down the mob to their calves. Handle cows and calves in a way that will prevent or minimise them being separated.
• Get your weaner training program and stockhandling right so that cows are calm when handled and are not rushing around forgetting their calves.
Mothering up for identification purposes

Often you may need to identify which calves belong to individual cows if a mob is being drafted to go to different paddocks, to identify weaner mothers or for herd improvement programs.

- Separate the calves from the cows overnight. The calves will then run back to their mothers when they are let back in the next day and will be easier to cut out.
- Hold the group of wet cows you wish to mother up in yards separated from the rest of the mob and use a creep which allows only calves to go under.
- On horseback in a large cooler, settle the mob and cut out pairs. You will probably find the slower you can move through the mob to cut out the faster you will finish.
- Some people use a paintgun or old vaccination gun with dye in it to mark calves and their mothers when they are mothered.
- DNA testing is an (expensive) option for situations where you need to identify progeny of cows and bulls.

SUMMARY OF BEST PRACTICE

- Minimise disturbances to a cow and newly born calf.
- Handle cows and calves in a way that will prevent or minimise them being separated.

Related topics
Heat Stress, Poddy Calf Rearing, Stock Handling.
Heifer Management

Tim Schatz, DoR Darwin

The way heifers are managed can have a large effect on their performance later as breeders. The main thing to keep in mind is that body condition has the biggest effect on heifer fertility and so management should aim to get heifers into the best condition economically possible.

Yearling management

After weaning, put heifers into a heifer paddock and keep them there separate from bulls until they are ready for their first joining, usually around two years of age. At this time some producers just put them in with the rest of their breeders while others join them in a separate group.

Joining weight

Joining weight has been shown to be the major factor in influencing fertility, providing there are no disease problems. Fertility increases with joining weight. Most heifers with high Brahman content on native pastures in the Top End region will not attain sufficient weight to be fertile until around two years of age. Some heifers can take longer if conditions are not conducive to good growth. A good target joining weight for maiden *Bos indicus* heifers is 300 kg.

There are significant benefits from managing heifers to increase joining weight. Conception rates of about 80% should result from heifers with at least a 300 kg joining weight mated over a 3 month period. Heifers can be joined at lighter weights, as it is more desirable that they conceive at the right time of year. Heifers will probably get pregnant later in the year if bull control has not been successful and they have not previously conceived. This will result in them calving out of season and will increase the chances of the heifer and/or the calf as well as increasing their inter-calving interval.

Timing of joining

The timing of joining should be set so that heifers will be calving just before pasture conditions are at their best. This will allow heifers to have access to the best possible nutrition while lactating. Other factors that affect the timing of when bulls are put in with the heifers include availability of labour and access to paddocks. Many properties put the bulls in paddocks as the last job before the onset of the wet season when access may become an issue.

In the Top End region, most heifers conceive in January or February after a couple of months of good growing conditions making December a good time to put the bulls in with the maiden heifers.

Fertility and re-conception

The fertility of lactating first calf heifers is the lowest of all females in the herd with re-conception rates after the first calving often being less than 20% by the first-round muster. Fertility is lowest in lactating first calf heifers because of the high nutritional requirements necessary for lactation and maternal growth to occur at the same time. As a result, lactating first calf heifers are often in poor condition and will not re-conceive until after weaning and spending several months on good feed.
Body weight/condition is the major factor influencing re-conception rates. Segregation of heifers from weaning until their first calf is weaned allows them to be managed so that their condition can improve (for example, with supplementary feeding). Early weaning of their calves will also help to reduce loss of condition. Small calves (under 100 kg) may require special management.

**Bulls**

If possible, it is best to use young bulls (about two years old and vaccinated for vibriosis) on maiden heifers. Bull control can be difficult on larger properties in the Top End region (due to flood fences being washed down, scrub bulls and missed bulls) so there is always a chance heifers may come into contact with a bull infected with vibriosis.

Selecting bulls that produce low birth-weight calves (e.g. Brahmans) will reduce the likelihood of calving difficulties.

**Mating system**

A limited joining period at the first joining is a good idea so that heifers do not get pregnant and have their first calf at undesirable times of the year (e.g. middle of the dry season).

**Vibriosis vaccination**

Experiments in the VRD region have shown a benefit from vibriosis vaccinating maiden heifers prior to their first joining.

**SUMMARY OF BEST PRACTICE**

- Use young bulls and bulls that produce low birth weight calves.
- Segregate heifers until target joining weight is achieved.
- Where possible, limit mating season to reduce out-of-season calves.
- Vaccinate bulls and consider vaccination of heifers for vibriosis.
- If possible, keep segregated from the rest of the herd until after their first calf is weaned. Extra targeted supplementation and early weaning techniques are more easily adopted.

**Further information**

Holroyd, RG and Fordyce, G (2001). *Cost effective strategies for improved fertility in extensive and semi-extensive management conditions in northern Australia*, Queensland DPI&F.


**Related topics**

Bull Selection, Mating Systems, Production Parameters, Supplementation, Vibriosis, Weaning.
Culling Breeders

Neil MacDonald, DoR Katherine and Barry Lemcke, DoR Darwin

Adult breeder cows are usually culled for low fertility, age, temperament or obvious physical problems (notably bottle teats).

Culling for low fertility

There are two main methods of identifying unproductive cows in a herd – either by pregnancy testing or by using an ear-tagging system that records lactation intervals.

Using pregnancy testing to identify culls

Cows are pregnancy-tested at the first-round muster and culled if empty and dry. The culled cows will be, on average, less fertile than those kept. Some producers may choose to pregnancy-test again at the second-round muster to ensure cows can be spayed to sell the following year.

In controlled mating systems, pregnancy testing should be carried out once only, 2 months after the bulls are removed.

Advantages

• a quick, one-step method
• no need to pregnancy-test at second-round musters.

Disadvantages

• Culling all empty and dry cows will remove some potentially productive animals that just had their last calf at the ‘wrong’ time of year. This is negated by controlled mating.
• Through this system, cows with a long inter-calving interval of up to 18 months are not culled as they are generally either pregnant or wet. A herd with a high proportion of such sub-fertile breeders will not be able to achieve high weaning rates above about 80%.
• Pregnancy-testing does not identify the cows that habitually abort or be poor mothers and fail to look after and raise their calf.

Greater selection pressure can be applied by pregnancy-testing wet cows too and drafting off those that have not re-conceived. Few stations could afford to do this every year because it is difficult to keep inter-calving intervals to under 12 months, and in some years an unsustainable number of cows would be identified for culling.

Tagging system to identify culls at consecutive musters

A tagging, notching or tattooing system may be devised to track cows’ wet/dry status at muster. Different coloured tags might be used to reflect wet/dry status, or a mark made on an existing tag. Alternatively, use of NLIS tags and a computer database to record animal history may be useful for tracking the wet/dry status of individuals.

Advantages

• identifies cows that are always pregnant but do not often raise a calf
• no need for pregnancy testing.

Disadvantages

• needs ear tags
• needs accurate record-keeping
• not as efficient as pregnancy testing as the non-pregnant cows are still in the herd for 3 years rather than 2.
Example of a tagging system
(assuming cows are mustered twice a year)

If dry, put in tag button (different colours each muster and for first or second time dry). Keep a meticulous record of the coloured tags used for each muster.

If cow is wet next time she is in the yard, remove the tag.
If cow is dry three times in a row – cull.

<table>
<thead>
<tr>
<th>Cow</th>
<th>1st muster</th>
<th>2nd muster</th>
<th>3rd muster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow 1</td>
<td>Dry</td>
<td>Dry</td>
<td>Dry</td>
</tr>
<tr>
<td>Cow 2</td>
<td>Dry</td>
<td>Wet</td>
<td>Wet</td>
</tr>
<tr>
<td>Cow 3</td>
<td>Dry</td>
<td>Wet</td>
<td>Wet</td>
</tr>
<tr>
<td>Cow 4</td>
<td>Wet</td>
<td>Dry</td>
<td>Dry</td>
</tr>
<tr>
<td>Cow 5</td>
<td>Wet</td>
<td>Dry</td>
<td>Wet</td>
</tr>
<tr>
<td>Cow 6</td>
<td>Wet</td>
<td>Wet</td>
<td>Dry</td>
</tr>
</tbody>
</table>

Culling for age
According to the 2004 Pastoral Industry Survey, producers cull breeders at an average age of 11 years, with a minimum age of 10 and a maximum of 12. After 10 years, mortality rates can increase and fertility can decrease. The best option is to check the animal’s teeth – if the teeth are okay, a cow can go on producing until about 16 years old. Some country can be harder on teeth than other areas. A cow can remain in the herd provided fertility and calf growth rate are maintained.

Culling for temperament
Temperament is a highly heritable trait. There are economic benefits and occupational health and safety benefits in culling for temperament. Cattle with poor temperament have more carcase bruising (especially in the expensive, high-quality meat cuts) and tend to have tougher meat. These cattle can also “stir up” quieter cattle.

Heifers with poor temperament can be identified and culled during weaner training.

Culling for physical problems
Several physical problems require culling e.g. stringhalt. Bottle teats is a genetic weakness that rarely improves, and it is best to reduce the incidence in the herd by culling. Bottle-teated cows that are still wet can be identified for later culling by using a tagging system. Cows with a prolapse of the vagina or uterus after calving should also be culled.

Current Situation
Options for cull cows in the Top End are currently limited. The live export to Indonesia does not accept cattle over 350 kg, nor does Islamic practice permit transport or slaughter of pregnant animals.

The nearest commercial abattoirs in coastal Queensland or southern Australia are over 2000 km away and the transport cost means that only fat cull cows are worth sending. Generally that requires cull cows to be spayed and fattened over a year. There is optimism that a Top End abattoir will be established in the next few years. This is expected to concentrate on cull cows and other cattle that do not meet the specifications for the live export trade.

The value of cull cows compared to feeder steers and heifers greatly affects station economics and practices.

Sources


Jackson, D (2005). Cattle Temperament – Much more than ease of handling, QDPI.

Related topics
Breeding, Polled Cattle, NLIS, Pregnancy Testing, Stringhalt, Weaning.

SUMMARY OF BEST PRACTICE
- Cull for low fertility, using pregnancy testing or a tagging system to identify empty, dry cows and those cows which do not rear a calf.
- Check teeth in older cows.
- Cull for temperament.
- Cull for physical problems.
Chapter Four: Cattle Management

Cattle and land management best practices in the Top End region 2011
# Chapter Four: Cattle Management

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Animal Equivalents

Animal Equivalents (AEs), also known as Adult Equivalents, are used to standardise stocking rates. There are several different systems in which the size of animals designated as 1AE varies. As long as the ratio between classes of animal is soundly based (from nutritional tables) any of these systems can be used.

In the Northern Territory, a 420 kg cow or steer at maintenance is commonly considered to be 1AE (Table 1). There is very little difference between the feed requirements of a steer and a dry cow. A key understanding is that lactation adds greatly to the feed requirements of the animal, so a wet cow is more than 1AE. Therefore, a paddock which has a safe carrying capacity of 1000 AEs could be stocked with 1000 dry cows or 769 (1000 divided by 1.3) wet cows.

Table 1. Animal equivalents of different classes of stock

<table>
<thead>
<tr>
<th>Class of stock</th>
<th>Animal equivalent rating</th>
<th>Average liveweight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Females</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weaner (up to 18 months)</td>
<td>0.50</td>
<td>200</td>
</tr>
<tr>
<td>Heifer (18–30 months)</td>
<td>0.75</td>
<td>300</td>
</tr>
<tr>
<td>Dry cow (&gt; 30 months)</td>
<td>1.00</td>
<td>420</td>
</tr>
<tr>
<td>Wet cow</td>
<td>1.30</td>
<td></td>
</tr>
<tr>
<td>Typical average value for adult cows in a well performing herd (with weaning rate of 75%)</td>
<td>1.20</td>
<td></td>
</tr>
<tr>
<td><strong>Males</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weaner (up to 18 months)</td>
<td>0.50</td>
<td>210</td>
</tr>
<tr>
<td>Two-year-old (18–30 months)</td>
<td>0.80</td>
<td>330</td>
</tr>
<tr>
<td>Three-year-old (30–42 months)</td>
<td>1.00</td>
<td>420</td>
</tr>
<tr>
<td>Four-year-old (45–54 months)</td>
<td>1.20</td>
<td>600</td>
</tr>
<tr>
<td>Bull</td>
<td>1.50</td>
<td>650</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Horses</td>
<td>1.20</td>
</tr>
</tbody>
</table>

Further information
MLA EDGEnetwork® Grazing Land Management course. Contact Pastoral Production Extension Officer DPI&F Katherine, Ph: (08) 8973 9763.

Related topics
Carrying Capacity, Production Parameters.
Animal Welfare

The Late Mauricio Perez-Ruiz, formerly DRDPIFR Darwin

The basic needs for the welfare of cattle are:

• adequate water, feed and air to maintain good health
• comfort and freedom to move and express normal behaviour patterns
• protection from pain, disease, injury or predation and appropriate action taken if it does occur
• protection from unnecessary, unreasonable or unjustifiable pain or suffering
• precautions against the effects of natural disasters such as flood or drought.

The five freedoms below are now universally accepted.

1. Freedom from Hunger and Thirst
2. Freedom from Discomfort
3. Freedom from Pain, Injury or Disease
4. Freedom to Express Normal Behaviour
5. Freedom from Fear and Distress

Water

Cattle must have access to an adequate supply of suitable drinking water at all times. They should not be deprived of access to water for periods exceeding 24 hours, unless in transit in which case the Standards and Guidelines for the Land Transport of Livestock apply. See Water Consumption topic for approximate consumption requirements.

Feed

Cattle must have access to feed that will maintain their well-being. They should not be deprived of feed for periods longer than 48 hours. Animals in poor condition, in late pregnancy or early lactation should not be deprived of feed for periods exceeding 24 hours. Available feed should meet the requirements of maintenance, growth, pregnancy and lactation and provide for extra demands such as cold stress or exercise.

Arrangements should be made for a continued supply of feed in the event of drought or seasonal feed shortages. If pasture is poor in quality or quantity, stocking rates should be reduced accordingly. Nitrogen and phosphorous supplementation is recommended in most of the Top End region.

Precautions against the effects of natural disasters and predation

Plans should be made and reasonable steps taken to ensure protection from the effects of natural disasters. In areas subject to flooding, care is necessary in paddock and facility design to allow access to high ground or to plan for stock evacuation to high ground.

Cattle must be attended to after a natural disaster such as a wildfire or flood. Animals should be assessed by a competent person. Immediate treatment or euthanasia may be required, depending on the animal’s condition.

All reasonable care should be taken to protect stock from predators.

Cattle handling facilities, mustering and yarding

Sheds, pens, lanes, ramps and other areas where cattle come together should be constructed and maintained to minimise stress, injury and disease. The design and construction of these should enable dust and noise to be minimised. Holding yards should be designed to minimise stress or injury and to allow all animals to stand, lie down, stretch and groom. Care should be taken to avoid over-crowding.

Thought should be given to the handling of unmanageable cattle. If they cannot be retained in the mob when mustering, they should be captured and transported, euthanized or left behind. Methods such as the use of shotgun pellets are unacceptable from an animal welfare perspective.

When mustering, consideration should be given to animals in poor condition or under other stress. They can be captured and transported, or if this would be too stressful, left behind near water.
Health

Appropriate preventative measures should be used for diseases that are common in the district or are likely to occur in the herd. Sick, injured or diseased cattle should be treated promptly and appropriately or euthanized.

Euthanasia of cattle

The preferred methods are:

- Overdose of anaesthetic under veterinary supervision.
- Using gunshot or captive-bolt pistol by the frontal method. The captive-bolt pistol or firearm should be directed at the point of intersection of lines taken from the base of each ear to the opposite eye (Figure 1).

Euthanasia of cattle

Transport

Transport stress is usually indicated by weight loss, dehydration, reduced feed intake, physical injuries or respiratory disease. Limiting pre-delivery stress will minimise the stress load on animals. Ensuring stock are not over-crowded, but are loaded firmly enough to minimise unnecessary movement in transport can help reduce transport-related problems. The longer the travel time, the more weight loss occurs, mostly by loss of body water. Cattle can be treated with electrolytes on long road transport trips.

Under the new Standards and Guidelines for the Land Transport of Livestock, the maximum allowable duration of a journey is primarily determined by the maximum amount of time that cattle can be deprived of water. For mature dry cattle, the maximum allowable duration is 36 hours. This can be extended to 48 hours if the animals are not showing obvious signs of fatigue, thirst or distress, and if the extension allows the journey to be completed within 48 hours. Diseased, in poor condition, sick, injured, weakened stock and heavily pregnant animals must not be consigned to travel. Once the new standards are finalised, it will be an offence to transport such stock. Details are available in the “Is it fit to load?” booklet available through the MLA.

Figure 1. Humane destruction of cattle (QDPI&F, 2011)

Sources


“Is it Fit to Load?” – MLA publication 2006. ISBN: 1 74036 775 8

Further information


Related topics

Branding, Castration, Dehorning, Stock Handling, Vaccination.

SUMMARY OF BEST PRACTICE

- Ensure animals have access to adequate supply of suitable drinking water and feed and are protected from natural disaster and predation.
- Ensure cattle handing facilities are designed to minimise animal stress and maximise animal comfort.
- Apply appropriate preventative measures for animal disease and treat sick or injured animals promptly and following animal welfare guidelines.
- Follow animal welfare procedures when carrying out husbandry procedures.
- Follow the Standards and Guidelines for the Land Transport of Livestock when transporting cattle.
The business benefits of training staff in animal handling are significant, leading to improved production gains, better meat quality and higher economic return for the livestock industry. Research shows that one of the major causes of losses in meat quality (bruises, mortality, meat downgrades) is poor handling of stock. Meat quality defects can be caused by poor transport and pre-slaughter handling (bruising and carcase downgrades). From a live export perspective, animals stressed by inappropriate handling during loading and transit have been shown to have higher shrinkage rates and take longer to go back on feed.

**Characteristics of cattle**

Good stockhandlers will have an understanding of behavioural characteristics of cattle and will:

- Realise that cattle view us as predators. Understand that because cattle are prey animals, their main instinct is for self-preservation. This can make them cautious and fearful until they have learned otherwise. Remember not to take cattle’s behaviour personally when they don’t do what we would like them to. They could feel like they are in a life or death situation.

- Understand that cattle fear novelty and that an unusual object, or something out of the ordinary may often be the reason for balking. They require time to make sure that it is not something that is going to hurt them.

- Know the importance of body language when working cattle. Cattle understand intent; if we have aggressive body language they will react to protect themselves from this.

- Appreciate that cattle are social herd animals. Separating an animal from the mob can be stressful for it. Understand that a mob has a social hierarchy and that mixing different mobs of cattle will affect this. Sometimes a handler will be less of a threat than a more dominant beast and the most direct line of escape might be straight past (or over) the handler. Stockhandlers should be aware of this as new social hierarchies are determined.

- Understand that cattle like to follow each other and that this can be used to the handler’s advantage.

- Understand cattle have poor depth perception which makes it hard for them to read how far away a handler is. Gentle side to side movement from a handler can help animals gauge where the stockperson is and help avert potential stand-offs. Give them time to look at where they are going.

- Know cattle have a limited field of vision which means anyone working outside their field of vision will cause cattle to turn around to see what is pressuring them (Figure 1).
Cattle and land management best practices in the Top End region 2011

Reducing stress requires handlers to have an ability to read the reactions and body language of the cattle and have a good understanding of a cow’s field of vision, and where to place themselves in that field of vision to achieve the desired result. The eye can be divided into three sections. Positioning in the forward section stops or slows the animals, the middle section allows you to travel with, or drift the animals and the moving into the rear section of the eye causes the animals to move forward away from the handler.

Undue stress is not necessarily caused by pressure being applied to an animal; it is more about whether the pressure is appropriate to the response required and if it is released quickly enough for the animal to learn that they can react in such a way as to remove the pressure (and that they are not going to be harmed by that pressure). Hitting and yelling should not be required. Livestock handlers must be observant enough to read the animal’s body language to gauge where they should be positioned, and have the timing to react quickly and remove themselves from the edge of the flight zone when the required amount of pressure has been applied to achieve the desired outcome. Little pressure is required when handlers are skilled observers of the animals. Handlers skilled at reading the livestock and placing themselves in the correct position in relation to the flight zone and the sections of the animals eye will have softer, more willing and less stressed (and more productive) cattle.

Working with the mob

Working the lead of a mob is an effective method of reducing the stress on livestock. Applying too much pressure from behind (particularly if the animals can’t see handlers) means animals are unable to gain relief from the stress of the move, causing them to break back over handlers or out of the mob. While an animal may be blamed for misbehaviour, invariably a handler’s incorrect position or inability to read the livestock has placed too much pressure on it, leaving the animal with nowhere to go, except out of the mob.

Observant livestock handlers look for the leaders in the mob, understanding that these animals will often be the most sensitive to pressure, and use these cattle to get the mob where they need to go. Brahman cattle are known for their following behaviour, and experienced stock people will capitalise on this. If the lead is worked correctly, the tail will follow.

In addition to the production benefits of training the animals, weaner tailing can be an excellent time to teach new staff to observe how a mob works, the effects of pressure and release, understanding flight zones, correct placement around the animal and the mob to achieve the desired direction and identifying leaders and their behaviour.

Poor stock behaviour in the cattle yards is often the result of poor handling in the mustering phase, and too many people in the wrong position in the yards.

Understanding livestock behaviour and using it to increase the welfare of animals and staff is rewarding from a welfare and economic perspective. Livestock handling courses are a good way to gain ideas and information.

Pressure, release and position

Stress is not necessarily the same thing as pressure. Stress displays as a series of physiological symptoms such as raised cortisol (a stress hormone) levels and increased heartbeat which normally would help them to react to danger to save themselves. High levels of repeated exposure to stress, makes them more prone to illness and poor productivity. Cattle that have been desensitised to stressors of husbandry and transport are more likely to be calm and responsive when exposed to them again. Animals will quickly demonstrate signs of being stressed if pressures are applied which they do not understand or know how to react to or gain relief from.

Reducing stress in livestock does not mean no longer placing any pressure on livestock. Research shows that animals that have never been previously exposed to any handling or pressure experience more stress, ill health and lower growth rates than those who have received the right type of handling both prior to, and when they are trucked and placed in a new environment.

Reducing stress requires handlers to have an ability to read the reactions and body language of the cattle and have a good understanding of a cow’s field of vision, and where

Figure 1. Field of vision of a cow. They cannot see into the shaded area when their head is forward. (Blackshaw 1986)
SUMMARY OF BEST PRACTICE

- Implementing good stock handling techniques benefits staff and animals from welfare, OH&S and economic perspectives.
- Reducing stress requires an ability to read and respond to the animal’s body language, and to know how to remove the pressure from them.
- Stock handling requires knowledge of flight zones, when to apply pressure, when to release pressure and correct positioning of handlers.

Sources
Blackshaw, J (1986). Notes on some topics in applied animal behaviour, University of Queensland, St. Lucia. www.animalbehaviour.net

Further information

Dr Temple Grandins Website: Livestock Behaviour, Design of Facilities and Humane Slaughter. www.grandin.com
Working Dog and Stockhandling Courses. Contact Neil McDonald Ph: (08) 8973 9746.

Related topics
Transporting Cattle - Pre-transport Management, Weaning, Working Dogs.
Condition Scoring

Trudi Oxley, DoR Katherine, and Tim Shatz and Barry Lemcke, DoR Darwin

Body condition scoring (BCS) is an important tool for herd management and is basically the scoring of an animal’s overall body tissue reserves. This is normally done by visual inspection. It is a quick, cheap and easy way of describing the condition of animals to assist in making management decisions such as segregating for different supplementation regimes, predicting whether breeders are in adequate condition to conceive, and for describing sale cattle for marketing purposes. It can also be used to describe cattle for animal welfare purposes. Condition scoring is least useful for calves and young growing cattle, but it may still help to identify those animals with disease, genetic problems or poor maternal conditions.

It is important not to confuse body condition scoring with fat scoring. Some systems have evolved purely to estimate fat thickness, e.g. the Ausmeat system. Fat scoring involves palpation as well as visual assessment. Although some scoring systems suggest a high predictability of P8 fat depth, research using real-time ultrasound scanning shows that the variation within score is high, with substantial overlap between categories. Even though condition scoring is not as accurate as fat depth, it is a quick and practical tool.

Cattle management

Cows with condition scores of 1–4 on a 1–9 scale are unlikely to produce good conception rates.

The body condition score of beef cows at the time of calving has a dramatic impact on subsequent re-breeding performance. Cows that calve in a BCS 3 or 4 have difficulty exhibiting their first heat by three months after calving. Whereas cows that calve in BCS 6 or 7 have adequate nutrition and tend to cycle within three months of calving and will generally have a pregnancy rate better than 80% (Holroyd and Fordyce, 2002). Condition scoring takes into account frame size when describing the condition of cattle since average weights can be misleading (i.e. a short fat cow can weigh the same as a tall poor cow). Condition score at mating is more important than weight for determining if pregnancy occurs.

Cows of thin condition (BCS 4 or thinner) produce less colostrum and give birth to less vigorous calves which are slower to stand. These calves have been found to have an impaired immune system reducing their ability to overcome early calf-hood disease challenges. This illustrates the importance of targeting mature cows to calve in a BCS of at least 5. Because 1st calf heifers are still growing after calving, they need to be fed so they are a BCS of 6 at calving.

Condition score is affected by stocking rates, the type of season, weaning strategy, supplementation regime and the productivity of the country.

Northern Territory condition scoring

The condition scoring system recommended for use in the Northern Territory is based on scores from 1–9 described in the figures below. A body condition score five (BCS 5) cow is in average condition and represents a logical target for most cow herds, whereas a BCS 1 cow is extremely thin and a BCS 9 cow is extremely fat. The key areas for evaluation are the backbone, ribs, hips, pinbones, tailhead and brisket. Palpation of cows for fatness along the backbone, ribs, and tailhead will help refine your skill to visually score body condition.

If body condition scoring is new to you, it is recommended that operators mentally describe the condition in words first then convert that description to a number. For example, look at an animal and think it is between average and fat condition, then give a score 6. By using a numerical condition scoring system, drift in scoring can occur both within and between times of scoring. It is important that the same operator does the condition scoring to be compared.
Another system used is the Ausmeat system which describes fat objectively in millimetres and then this is converted into a fat score. Fat scores range from 1 (lean) to 6 (very fat). There is a National Beef Recording Scheme (NBRS) 1–8 condition scoring system, which has also been included for comparison in the figures. A 1–5 condition scoring system which is used in Queensland has also been included in the figures for comparison.

**Condition Score 1**  
(Ausmeat 1, NBRS 1,  
Fat = 0 mm)  
Marked emaciation. Pins sharp to touch, emaciated legs, protruding hooks, ribs clearly visible, small hump. Should either be destroyed or removed from the herd, dried off if wet and taken to the hospital paddock.

**Condition Score 2**  
(Ausmeat 1, NBRS 2,  
QLDBCS -1, Fat 0 mm)  
Wasted leg muscle, transverse processes project sharply, ribs clearly visible, slack skin over hump.

**Condition Score 3**  
(Ausmeat 2, NBRS 2,  
QLDBCS 1, Fat 0 mm)  
Ribs clearly visible, muscles slightly concave, pins prominent, tail head prominent, transverse processes visible individually, dorsal spine pointed.

**Condition Score 4**  
Poor, Low Fertility  
(Ausmeat 2, NBRS 3,  
QLDBCS 2-, Fat 4 mm)  
Ribs, hips and pins visible, transverse processes cannot be seen individually, unlike CS3.

**Condition Score 5**  
Backward Store  
(Ausmeat 3, NBRS 4,  
QLDBCS 2+, Fat 6 mm)  
Fat muscle, ribs and dorsal spine just visible.

**Condition Score 6**  
Forward Store  
(Ausmeat 3, NBRS 5,  
QLDBCS 3, Fat 9 mm)  
Hook visible, dorsal spines cannot be seen or easily felt, animal smooth and well covered.
**Condition Score 7**

Fat
(Ausmeat 4, NBRS 6, QLDBCS 4-, Fat 12 mm)
Dorsal spine can be felt with firm pressure but feels rounded rather than sharp, full hump, animal is smooth and well covered, but no major fat deposits.

**Condition Score 8**
(Ausmeat 4, NBRS 7, QLDBCS 4+, Fat 17 mm)
Obvious fat deposition, transverse processes cannot be seen or felt.

**Condition Score 9**
(Ausmeat 5, NBRS 8, QLDBCS 5, Fat 30 mm)
Heavy depositions of fat on tail head and brisket. Dorsal spine, ribs, hooks and pins are all fully covered and cannot be felt even with firm pressure.

*Photos from International Livestock Research Institute website*

**SUMMARY OF BEST PRACTICE**
- Be aware of the condition cattle need to be in.
- Learn to use the Northern Territory condition scoring.
- Use condition scoring to make management decisions such as the need to supplement, manipulate stocking rates or use better paddocks.

**Sources**


**Further information**

**Related topics**
Animal Welfare, Transporting Cattle – Pre-transport Management.
Reproductive performance measures

Reproductive ability for cows can be thought of as the ability for a cow to conceive and wean a calf each year following puberty and is commonly measured using pregnancy diagnosis, lactation status following pregnancy diagnosis or branding/weaning rates.

It is important to recognise that the common methods of measuring reproductive performance (such as calving rate, weaning rate and calving interval) represent the average of the herd, and not the proportion of the herd performing at the recommended targets. Focusing on the proportion of the herd that is performing at the recommended levels is particularly important when wanting to improve reproduction rates. An example of one of these measures is the proportion of the herd re-conceiving in less than three months or proportion of cows calving between October and December.

When investigating low herd fertility rates, it can be useful to calculate a number of reproductive performance measures to identify where losses are occurring. For example, a combination of pregnancy diagnosis, lactation status, branding rates and weaning rates will help to determine stages and possible causes of low herd fertility.

Pregnancy rate

Pregnancy rate represents the number of females conceived relative to the number joined. In practice, it is expressed as the number of females mustered and actually pregnancy tested.

\[
\text{Pregnant females} \times 100\%
\]

Females joined

Branding rate

Branding rate represents the proportion of calves branded relative to the number of breeders mated in the previous 12 months. Incorporated in this measure are pregnancy losses and calf mortality at calving.

\[
\text{Calves born within a 12 month period} \times 100\%
\]

Females joined in the previous 12 month period
Weaning rate
Weaning rate represents the proportion of weaners weaned relative to the number of breeders mated in the previous 12 months. Incorporated in this measure are pregnancy losses, calf mortality around calving and calf survivability to weaning which may include some husbandry practices such as dehorning or castration.

There are two common methods for calculating weaning rate.

**Method 1:**

\[
\text{Weaned CALVES} \times 100\% \quad \text{Females joined in previous 12 month period}
\]

**Method 2:**

\[
\frac{\text{Number of weaners in yard}}{\text{Number of cows in yard}} \times 100\%
\]

Method 2 is an easy way of working out weaning rate; however, it does not incorporate breeder mortalities or culling practices. It is not a realistic measure of breeding herd performance and Method 1 should be used where possible. The average estimated weaning percentage for the Darwin region in 2004 was 70%, with a minimum of 45% and a maximum of 95%.

Inter-calving interval
Inter-calving interval represents the herd’s average number of months between successive calvings. This measure also represents the average time for the herd to get back into calf (that is carried to term) after calving. Calculating inter-calving intervals relates to calving rate (Figure 1) and can be used in investigate where potential losses are occurring.

On site investigation of breeding herds has shown inter-calving intervals on commercial stations ranging between 14–15 months. Breeding herds at Victoria River Research Station have recorded ICI of between 13–13.5 months.

**Figure 1.** Relationship between inter-calving interval and calving percentage

![Graph showing relationship between inter-calving interval and calving percentage](image)

Losses from confirmed pregnancy to weaning
Research conducted in northern Australia has indicated that losses from confirmed pregnancy to weaning of 15–30% in heifers and 5–12% in breeder mobs are not uncommon. If reproductive losses greater than this are occurring, investigation is recommended.

Even though some of the causes of these losses have been determined, the relative contribution of each of these causes has not been determined. A study conducted on the Barkly Tablelands found that 63% of calf losses in heifers occurred during the peri-natal period. The peri-natal period is from just prior to birth, during birth and the first 28 days of life. These losses were primarily due to dystocia, mis-mothering and unknown causes.

Wet cow re-conception rate
Wet cow re-conception rate represents the proportion of cows that are pregnant and lactating and is generally recorded at 1st round muster. Wet cow re-conception rate in May/June is often between 35–45% on commercial stations. Wet Cow re-conception rate does not relate closely to weaning rate in continuously mated herds between years. It does represent the proportion of the herd capable of re-conceiving while lactating, which is sometimes used as the basis for a breeder being retained under intensive culling regimes. Wet cow re-conception can be especially low in second calf heifers (less than 10%).

Breeding herd efficiency
Breeding herd efficiency (BHE) is one of the most informative measures of breeding herd productivity. It is a measure based on weaner production from the weight of cows mated, and is therefore independent of cow size (maturity type). Breeding herd efficiencies are commonly presented as kg weaned per 100 kg breeder mated, 1 tonne of breeder mated or per AE. It is recommended that the kg weaned per AE be adopted. A benchmark is 150 kg weaned per AE mated (33.5 kg weaned per 100 kg breeder mated).

\[
\text{BHE (kg/AE mated)} = \frac{\text{kg weaned}}{\text{kg of breeders mated in previous 12 month period}} \times 420
\]
Turn-off efficiency
A more complete measure of breeder herd productivity that can be used is turn-off efficiency. It is a measure based both on weaner production and breeders sold from the weight of cows mated the previous year. This measure is commonly presented as either kilograms per AE mated or kilograms per square kilometre.

\[
\text{kg/AE mated} = \frac{\text{kg weaned} + \text{kg surplus & cull breeders sold} - \text{kg replacement breeders added}}{\text{kg of breeders added} \times 420}
\]

\[
\text{kg/km}^2 = \frac{\text{kg weaned} + \text{kg surplus & cull breeders sold} - \text{kg replacement breeders added}}{\text{Area (km}^2\text{)} \text{ herd utilised in previous 12 month period}}
\]

Mortality rate
Breeder mortality rates are often underestimated and can be difficult to determine between years. The average Darwin district mortality rates were estimated at 2.7% for breeder cows and 3.4% for aged cows, according to the Pastoral Industry Survey 2004.

Results from well managed recorded herds indicate that annual breeder mortality should be less than 2%.

Weighing cattle
Weighing cattle is an accurate but imprecise measure due to an animal’s weight being greatly influenced by gut fill. Liveweight measurements are more precise when cattle have been through a curfew period, reducing the variation in gut fill between animals. Curfews generally either wet or dry and are usually conducted over a 12 hour period (a night). A wet curfew refers to removing access to feed but allowing access to water. A dry curfew refers to removing access from both water and food. Animals under a dry curfew lose approximately 7% of their full weight after 12 hours.

Stage of pregnancy also influences liveweight and can be corrected for using Table 1.

Liveweight gains
The liveweight gain (LWG) of an animal is influenced by a number of factors including age, condition, stocking rate, pasture type, maturity type, genetics, disease and environmental factors to name a few. A large amount of variation exists between regions and within herds.

Post weaning performance in the Top End region has been recorded as between 100–150 kg/ha/yr depending on the location. Animals put on a majority or all of their weight during the wet season with little or no liveweight gains recorded across the dry season. Some animals may even lose weight throughout the dry season. The lighter weight group weaners usually perform better during the dry season and throughout the year than their heavier counterparts.

Pre-weaning liveweight gain, or calf growth, apart from timing of calving, is a major influencing factor of weaning weight. Factors that may influence pre-weaning weight gains are nutrition (both cow and calf), genotype, and sex.

<table>
<thead>
<tr>
<th>SUMMARY OF BEST PRACTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Learn expected production parameters.</td>
</tr>
<tr>
<td>• Monitor herd performance.</td>
</tr>
</tbody>
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Source

Further information


Related topics
Bull Selection, Heifer Management, Weaning.

Table 1. Weight of gravid uterus to correct cow weight for pregnancy (O’Rourke et al., 1991)

<table>
<thead>
<tr>
<th>Months pregnant</th>
<th>Weight of gravid uterus (kg)</th>
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</table>
**Weaning as a herd management tool**

The ideal minimum size of weaners is a topic for debate amongst Top End pastoralists. Weaning is principally to protect cow condition, so the timing and frequency of weaning and size or age of weaners may vary between properties depending on the nutrition available. The average weight of the weaner crop can be much higher than the minimum weaning weight and will depend on when peak calving occurred.

A 100 kg weaning weight is a good compromise between the requirements of the calf and maintaining adequate condition of breeders. A body condition score five (BCS 5) cow is in average condition and represents a logical target for most cow herds.

Producers in the Darwin region indicated in the Pastoral Industry Survey (2004) survey that their minimum weaning weight averaged 106 kg for both first and second round musters. Fifty percent of Top End producers wean by age and 41% at a different weight each year according to seasonal conditions.

Brahman cattle are particularly subject to lactation anoestrus where a breeder experiencing inadequate nutrition is prevented from cycling due to the hormonal response to suckling of a calf. In order to achieve a 12 month calving interval or less, breeders have to maintain sufficient body reserves to cycle and re-conceive within three months of calving. Weaning generally needs to be carried out twice-yearly in continuously mated herds to counter lactation anoestrus and the difficulty of maintaining breeder condition during the harsh dry season. Evidence from north Queensland shows that weaning at the start of the dry season conserved breeder liveweight by 10–15 kg/month over the dry, about twice the benefit of feeding urea-based supplements (Dixon, 1998).

A higher incidence of breeders with insufficient body reserves to re-conceive soon after calving results in these breeders lactating during un-favourable conditions and high numbers of out-of-season calves. Consequences of this include increased breeder mortality and supplement costs and having to keep young stock longer in order to reach target turn-off weights.

Early weaning is weaning from 100 kg down to 60 kg or less, sometimes warranted under conditions such as dry years or to ensure survival of heifers. Some producers practice this successfully but the cost and benefits need to be carefully considered. This decision requires balancing the economics of the infrastructure, feeding and management costs of maintaining such young weaners against the costs of breeder mortality and anoestrus and supplement/feed required to prevent breeder mortality over poor seasons.
Weaning processes

Training
As with people, the younger you are, the easier it is to learn. Weaning is an ideal time to expose cattle to and equip them to handle the stresses they will need to handle later in life. Ensuring their first experience is as pleasant as possible (providing feed, water and a free run through the handling facilities) reduces the stress experienced when husbandry procedures are practised on them throughout their lifetime. Keeping weaners in yards for at least five days also allows them to learn to eat novel foods such as hay, pellets or supplements, establish social orders in confined spaces and de-sensitises them to noises and movements of people and vehicles.

It is important to expose weaners to all of the types of handling they will receive later in life e.g. tailing out on horseback during the day will teach them to be handled by horsemen, working them through the yards on foot will familiarise them with people on the ground. Having a few quiet trained older animals with the weaners is a good way of helping settle the weaners down more quickly and provides a lead for fresh weaners to follow.

Research undertaken through the Beef Co-operative Research Centre into the effects of yard weaning on subsequent feedlot performance found that after 90 days on feed, the estimated added value of yard weaning, even after deducting costs, was $25/head over cattle just weaned into the paddock. This benefit was mainly attributed to increased growth rates when on feed.

Nutrition
The most cost-effective strategy for feeding weaners over 100 kg is to provide wet season spelled pasture with a urea-based supplement in the dry season and a phosphorus-based supplement during the wet season.

Early weaned calves require an energy and true protein source, in addition to good quality hay or saved pasture. Sources of energy and true protein include feeds such as copra meal and calf pellets. The main costs of early weaners are the nutrition, infrastructure and management costs, but it is generally cheaper to feed the weaner than to supply sufficient supplement to a lactating cow. Weaners’ rations need to ensure animals below 100 kg are growing at least 0.4 kg/day weight gain to prevent stress-related post-weaning diseases such as coccidiosis. When feeding in yards, drafting weaners into lines according to size helps to prevent bullying.

Consult an Animal Production Officer for assistance with formulating rations and calculating the cost of different strategies for feeding weaners.

Health
Coccidiosis is a major threat to weaners under nutritional stress. Including rumen modifiers such as Rumensin™ in a ration will help prevent the incidence of coccidiosis. All weaners should receive immunisation for botulism and 7in1 or 5in1 vaccinations at weaning.

SUMMARY OF BEST PRACTICE

• Wean twice-yearly, as early as possible in the dry season, down to 100 kg.
• Wean once only in controlled mating systems.
• Feed weaners smaller than 100 kg with an energy and true protein source.
• Handle weaners in yards, on horseback and foot, teach them to eat hay and drink from troughs.
• Vaccinate all weaners against botulism.

Sources


Further information


MLA EDGENetwork® – The Breeding Edge course. Contact Pastoral Production Extension Officer, DPI&F Katherine, Ph: (08) 8973 9763.

MLA EDGENetwork® – The Nutrition Edge course. Contact Pastoral Production Extension Officer, DPI&F Katherine, Ph: (08) 8973 9763.

Related topics
Botulism, Castration, Coccidiosis, Culling Breeders, Dehorning, Production Parameters, Stockhandling.
Poddy Calf Rearing
Jessica Mayes, formerly DPIFM Katherine and Barry Lemcke, DoR Darwin

As the value of cattle has increased over the past two decades, the rearing of poddy calves has become economically justifiable. Calves can become ‘poddied’ for a variety of reasons and may be in quite poor shape when received. They may require extra attention initially if dehydrated, depressed, lacking appetite or scouring.

Dehydrated calves
Dehydration should be treated before feeding with milk. Administration of an electrolyte mixture will increase their chances of survival. Electrolyte mixtures are commercially available or a home-made mixture may suffice (mix 1 teaspoon table salt, ½ teaspoon baking soda and 125 mL glucose in 1.2 litres of water). Once the calf is stabilised, a milk feeding routine can begin.

Insertion of a stomach tube may be necessary if the sucking reflex is not present, or the calf is too weak.

Colostrum
It is vital that the newborn calf receives colostrum within six hours of birth from its dam or artificial sources. Colostrum is the first milk secreted by the mammary gland during the first days following birth, and is characterised by high protein and antibody content. The colostrum provides passive immunity to disease and helps build up vitamin and mineral levels. Once the calf has received colostrum, it can be fed solely on whole milk or milk replacers, until the calf’s rumen develops to a stage where it can digest solids. Some milk replacers now contain colostrum. Retain a supply of colostrum when available in a freezer for later emergency usage if the cow cannot be hand milked.

Feeding routine
• Care must be taken not to overfeed calves, especially during their first three weeks of life. Overfeeding will cause scour, as will too short an interval between feeds.
• Feeding twice a day is satisfactory.
• Once a day feeding may begin at two to three weeks of age if the calf is healthy and eating well. The total daily requirement of milk should be fed in the morning and plenty of cool, fresh water provided for the rest of the day.
• Calves on once a day milk feeds usually have a good appetite for dry feed and are easier to wean onto solids.

Milk replacers
• Milk replacers are available at stock and station agents and feed stores.
• The milk replacers should be reconstituted and fed as directed by the manufacturers, usually 1 kg of powder to 10 litres of water and feed at a daily rate of 10% of calf bodyweight.
• Increasing the proportion of powder is often recommended for once a day feeding to reduce the total volume of milk replacer/milk formula required. For example, a thriving, well-grown calf of 50 kg liveweight requires about 4.5 litres of milk formula.
• Milk may be fed at temperatures between 6 °C to 38 °C. It is generally recommended the milk temperature be between 35 °C to 38 °C. Once warmed, the milk should be used quickly to avoid possible scours.
Teat or bucket feeding?

Calves may be fed from a bucket or on teat feeders, both have advantages and disadvantages.

Initially, it may be easier to get calves to feed from a teat. Saliva production may be greater when teat feeding which could be beneficial for digestion or to maintain fluid intake in scouring calves. Teats have to be kept clean and replaced when they deteriorate.

To train a calf to drink from a bucket, back it into a corner, stand astride its neck and place two fingers moistened with milk into its mouth. As the calf starts to suck, gently lower its mouth into a bucket of warm milk taking care not to immerse the nostrils or it may inhale milk. This may have to be repeated several times before the calf will drink un-aided. Care must be taken that the calf does not become reliant on having a warm hand near its mouth. The base of the bucket should be placed at least 30 cm above the ground to ensure the oesophageal groove channels milk into the abomasum properly. Tall containers need to be avoided for this reason.

Regardless of the method used, it is important for each calf to receive a measured amount of milk daily. Teat feeders are more suited to feeding large numbers of calves but once older, a calf may drink more from the bucket than from a teat. The speed of drinking has little effect on milk utilisation.

Scours

Scouring can have several causes and can be a life-threatening condition. The calf may need to be taken off milk and placed on electrolytes until scour subsides. If scour continues, treatment with commercial medication may be warranted, in consultation with a vet. Too short an interval between feeds can cause scouring with fresh milk going into the stomach before the curd from the previous feed is fully utilised.

Water

Calves will begin to drink water between one and two weeks of age, and by six weeks may drink four to five litres a day. Milk feeding once or twice a day does not supply enough water for the calf, so fresh, cool water should be available at all times. Water consumption is determined by ambient temperature and will increase as temperature increases and humidity decreases.

Solid feed

- The calf should have access to solids from one week of age in the form of concentrates and good quality hay.
- Concentrates can be introduced by placing a small amount in the milking bucket. As the calf finishes drinking you can rub a little on its muzzle to encourage the calf to taste it. If feeding a number of calves, once one or two of them are eating the supplement, the rest will follow. By three weeks of age, a calf should be able to digest small amounts of grain, meals and hay and should be given access to young green pasture.
- Depending on the quality of the pasture, supplementary feed with hay and concentrates may be needed until the calf is about four months old.
- Calf concentrates should be highly palatable, coarse textured, high in energy (over 75%) and protein (over 16%) and low in roughage (less than 15%).
- A simple home-mix could consist of four parts cracked or crushed grain (oats, barley, sorghum, maize or wheat) and one part linseed, soybean, peanut, copra meal or cottonseed meal plus one part lucerne chaff. Molasses may be added to the mix to make it more attractive to the calf and encourage it to eat more.
- The inclusion of a rumen modifier such as Rumensin™ in feed will assist rumen activity and may help prevent coccidiosis. Care must be taken though, as poorly mixed or inappropriate doses of Rumensin™ are toxic.
- If pasture is scarce or of poor quality, supplement it with good quality hay, with a protein content over 10%.

Weaning

- The calf’s rumen must be functioning well before it can be weaned and time of weaning will depend on when this is achieved.
- If the calf has been offered solids from one week of age you may consider weaning it off milk at between five and eight weeks of age.
- Early weaning is only possible if the calf is healthy, eating well and consuming a minimum of 650 g of meal a day. Some calves will reach the target consumption earlier than others, so it is best to feed concentrates separately if feeding more than one calf. This will allow weaker calves to eat their full quota.
- Once the target consumption is reached, the calf can be weaned off milk by either reducing milk over a one week period or stopping the milk abruptly.

---

**SUMMARY OF BEST PRACTICE**

- Treat dehydration and scour before commencing milk feeding, if necessary.
- Newborn calves must receive colostrum (keep a supply in a freezer).
- Feeding twice a day is satisfactory, never feed more frequently.
- Milk replacers can be fed via a bucket or teat feeder.
- Good quality pasture, hay or concentrates should be provided before and after weaning.
- Wean when the calf is eating a satisfactory quantity of solid feed.
- Cool, fresh water should be available at all times.
- Be vigilant for worm infections when managing calves, particularly in large groups.
- If the calf is being poddied is related to a production fault, do not return the animal to the herd to avoid perpetuating a genetic fault.

**Sources**


**Further information**


**Related topics**

Coccidiosis, Weaning.
Regulatory requirement

The Northern Territory Livestock Act and Regulations uses a three-letter brand system where one letter must be the letter 'T' and a distinctive (symbol) brand system.

It is compulsory to brand cattle before they are moved off a property or are sold (unless they are less than eight months of age). Brands can be used on horses, buffalo and camels but it is not compulsory.

A brand is registered to a person or company for use on a nominated property. This means the branding iron can only be used by the registered owner (or their representative) on the registered property. It does not restrict branded cattle being agisted on other properties. To brand on a property not registered with the Registrar of Brands is an infringement of the Livestock Act and Regulations and is an offence that incurs a penalty.

Owners of brands must give notification to the Registrar of Brands in the following events:

• change of property (moving from the registered property or selling the property)
• change of branding position required
• cancellation required
• change of name by marriage
• notification of death
• transfer to a new owner
• change of contact address.

When a property is sold and the sale may include the stock, but the brand cannot be sold to the new owners. An agreement may be made in the sale contract to transfer the brand to the new owners. Transfers must be lodged with the Registrar of Brands. Alternatively the brand may be cancelled or Change of Run, moving the registration to a new property.

The Northern Territory Livestock Act and Regulations can be obtained on the NT Government website.

In any proceedings, proof that an animal is branded in accordance with the provisions of this Act with a registered brand is prima facie proof that the animal is the property of the owner of the registered brand.

Animal welfare considerations

Good restraint is essential for achieving fast and efficient branding. To minimise discomfort to the animal:

• check it is properly restrained
• check the irons are at the correct temperatures (blue hot, not black or red hot)
• apply hot irons for 2–3 seconds only
• do not brand wet or emaciated, weak animals
• preferably brand young animals between two and six months old.

Branding irons need to be cleaned regularly to stop smudging from built-up hair and skin and to reduce heat conduction. A wire brush and/or a bucket of sand are good tools to have whilst branding to ensure the branding irons can be easily kept clean.
SUMMARY OF BEST PRACTICE

- Register a brand.
- Brand between 2 and 6 months of age.
- Properly restrain the animal.
- Have the irons at the correct temperature.
- Keep the irons clean.

Source

Further information
Regional Livestock Biosecurity Officer, Darwin, Ph: (08) 8999 2030.
Livestock Identification Systems Administrator (LISA) / Brands, Ph: (08) 8999 2033.

Related topics
Animal Welfare, Livestock Movement, NLIS.
National Livestock Identification System (NLIS)

Sharon Kearney, DoR Darwin

The National Livestock Identification System (NLIS) has been introduced to provide rapid and accurate tracing of livestock movements across all Australian states and territories. The purpose of NLIS is to underpin consumer and market confidence in the safety and integrity of Australian livestock and livestock products.

The National Livestock Identification System (NLIS) has been introduced to provide rapid and accurate tracing of livestock movements across all Australian states and territories. The purpose of NLIS is to underpin consumer and market confidence in the safety and integrity of Australian livestock and livestock products.

NLIS in cattle uses radio frequency identification devices (RFIDs) and the NLIS database to record individual animal movements between properties.

All properties in the NT that have livestock are required to register their property with DPI&F to obtain a Property Identification Code (PIC). Having a PIC for your property is essential for NLIS.

The NT Legislation that underpins the registration of properties that have livestock and NLIS identification is contained in the Livestock Act and Regulations.

All cattle that leave the boundaries of a property must be identified with an RFID.

The NT has one exception where an RFID is not required to be attached.

NT cattle that are travelling from their property of birth directly to Darwin Wharf (through an approved export depot) for live export are not required to be identified with an RFID.

There are two types of NLIS devices or RFIDs used for the permanent identification of cattle: breeder tags and post-breeder tags.

Breeder tags are white and are used to permanently identify cattle before they leave their property of birth.

Post-breeder tags are orange and are used to permanently identify introduced cattle that were not born on the property.

The Property Identification Code (PIC) and NLIS logo are on the front of the tag. Tags must not be removed. Cattle should only be tagged with an RFID once, either with an NLIS breeder device or an NLIS post-breeder device. If purchased cattle or buffalo already have an RFID attached do not remove or attach another RFID.

The RFID tag is issued to a specific property only and cannot be applied to cattle on another property. NLIS tags cannot be sold, given away or re-used.

RFID Tags must be attached to the right (offside) ear, as shown.
It is the responsibility of the origin property owner to ensure that all cattle are correctly tagged with NLIS tags before leaving the property. It is the responsibility of the property owner receiving the cattle to transfer the cattle to the destination property on the NLIS Database.

DPI&F Regional Livestock Biosecurity officers can provide further information and advice on NLIS to livestock owners.

**SUMMARY OF BEST PRACTICE**
- NLIS is mandatory in the Northern Territory for cattle moving off a property.
- It is the origin property owner who is required to ensure all cattle are correctly tagged with RFIDs.
- It is the destination property owner who is required to transfer all cattle to the destination property on the NLIS database.

Source
NLIS fact sheets DPI&F.

Further information
Email: ntnlis@nt.gov.au

Fact Sheets are available on the following topics:
- Summary of Cattle Identification and Documentation Requirements for moving stock within the NT and interstate– 2009
- Property Identification Code (PIC) Registration
- How to Find a Property Identification Code (PIC) for a Northern Territory Property
- Opening an account with the NLIS Database
- Update your Property Details
- NLIS contacts - Interstate and NT
- Getting started with NLIS
- RFID Readers
- Ordering NLIS Devices
- NLIS for shows, rodeos sporting events
- NLIS database transfers
- NLIS for buffalo in the NT
- NLIS for saleyards
- NLIS devices for agistment cattle
- NLIS for trucking yards, dip yards
- NLIS Live Export Cattle
- NLIS for NT Abattoirs


NLIS Database Helpdesk Phone: 1800 654 743
Email: nlis.support@mla.com.au

Related topic
Live Cattle Export Industry, Livestock Movements.
Dehorning

Jessica Mayes, formerly DPIFM Katherine

Dehorning calves is an essential management practice for the Northern Territory’s cattle industry. It is vital that dehorning and castration of weaners takes place as the last acts in the weaning process before they are moved to a weaner paddock. This minimises the risk of infection of any open wounds. Cool and dry conditions are best as wet weather significantly increases the risk of infection and longer healing time.

Dehorning should only occur once in an animal’s life. Having to dehorn an animal again because it wasn’t done properly the first time causes undue stress. When dehorning, it is essential that the whole horn bud is removed. To do this, a ring of hair or skin at least 1 cm in diameter must be removed from around the horn base. Dressing the wound with a commercial wound disinfectant that includes a fly repellent will help minimise the risk of infection if the calf is to be weaned. Dressing the wound is unnecessary if the calf is to be returned to its mother, as she will lick it. Care should be taken when handling medications as some are listed on the poisons schedule and can be harmful to humans.

Export

Polled or dehorned cattle are preferred for live export. However, cattle with horns 12 cm or less in length and blunt are eligible. Dehorning wounds must be healed prior to selection for export.

Transport

Polled or dehorned cattle are preferred when transporting cattle. Cattle with horns may be transported within Australia with no ban associated with horn length, however, additional space must be provided during transport. Dehorning wounds must be healed prior to transport.

Main methods of dehorning cattle in the Northern Territory

Dehorning knives

Ideal for young calves less than two months of age, where the horn bud has not attached to the skull. The cut should start 2 cm from the base of the horn bud. It is essential that a complete ring of hair is removed to ensure that no horn-forming tissue remains to grow into a scur.

Scoop dehorners

These are ideal for calves two to six months of age, where the horn bud has attached to the skull. Scoop dehorners can open the frontal sinus creating a large hole – something that should be avoided wherever possible because of the increased risk of infection.

Cup dehorners

These are suitable for older calves. A drawback with this design is that the front of the dehorners may ‘ride up’ the horn, resulting in partial removal of the horn bud and increased likelihood of a scur forming. This can be avoided by a second person pushing down on the front of the dehorners or by taking several ‘cuts’.
SUMMARY OF BEST PRACTICE

- A complete ring of hair must be removed to ensure that no horn-forming tissue remains to grow into a scur.
- Use sharp instruments.
- Ensure proper calf restraint.
- Use appropriate disinfectants of the correct strength and change regularly.
- Reduce dust to minimise contamination, maintain operator hygiene and keep facilities clean.
- Remove processed animals from yards as soon as possible.
- Process as many animals as possible as calves rather than weaners.
- Dehorn and castrate weaners as the last acts in the weaning process.

Source

La Fontaine, D and de Witte, K (2002). Dehorning and Castration of Calves under Six Months of Age, Agnote No. J83, DoR.

Further information

Dehorning Cattle, NSW DPI.

Live Export Accreditation Program (LEAP).


Related topics

Castrating Calves

Jessica Mayes, formerly DPIFM Katherine

Calves should be castrated at the youngest possible age. There are two main methods of castration in the Northern Territory: surgical and by using rubber rings.

Surgical castration

1. Check that both testes are present in the scrotum.
2. Trap one of the testes against the base of the scrotum by firmly squeezing the testis.
3. Make a positive incision on the trapped testis with a sterile scalpel.
4. The incision should be as close as possible to the apex of the scrotum to assist in drainage of the wound.
5. Ensure that the incision in the skin and the thick fibrous capsule surrounding the testis is long enough to allow the testis to be squeezed out through the incision.
6. Cut the fibrous tissue (which holds the epididymis to the tunica vaginalis) close to the body so that the cut tissue, testis and epididymis are free to be removed.
7. The testis should now be pulled firmly away from the animal and removed in one tearing action without allowing it to re-enter the scrotum. Alternatively, as the testis is pulled away from the animal, the spermatic cord can be severed close to the animal using a scalpel.
8. Any obvious loose tissue should now be removed in a similar fashion.

Rubber ring castration

- Can be used on calves up to two weeks old.
- Rings must be purchased recently and be tight enough to shut off blood flow in arteries and veins.

1. Check that both testes are present in the scrotum. Squeeze testes against the base of the scrotum.
2. With the legs of the applicator facing the belly of the calf, squeeze the handles to stretch the ring so it can be placed over the scrotum.
3. Place the expanded ring over the scrotum and release the handles when both testes are trapped between the ring and the base of the testes.
4. It is important to release the ring just above the testes, not at the base of the scrotum.
5. The applicator can now be removed by slipping the legs from under the ring.
Age of cattle

Castration without local or general anaesthesia should be confined to calves at their first muster prior to weaning and preferably to calves under the age of 6 months.

Currently, castration can be carried out on bulls up to the age of 12 months. Under exceptional circumstances, bulls older than 12 months can be castrated by a veterinary practitioner. It is expected that, in the future, the Northern territory will fall into line with the majority of the States of Australia and reduce this age to 6 months.

**SUMMARY OF BEST PRACTICE**

- Castrate up to 6 months of age.
- Use sharp instruments.
- Scalpel blades should be changed for every 30 to 50 calves. No. 21 or 23 scalpel blades are ideal for castration.
- Ensure proper calf restraint.
- Use appropriate disinfectant at the correct strength and change it frequently. Keep scalpel blades in disinfectant when not in use.
- Keep branding and recovery areas as clean and dust-free as possible. Use sprinklers. Cleaning the cement floor will help minimise contamination.
- Maintain operator hygiene and keep facilities clean.
- Keep hands dry when castrating, as dirty water dripping from hands is a major source of infection.
- Because the prevalence of bacteria is high in yards, castrated animals need to exit the yards as soon as possible.
- Process as many animals as possible as calves rather than weaners.
- Dehorn and castrate weaners as the last acts in the weaning process so weaners can exit the yards as soon as possible after castration.
- Avoid trucking of recently castrated calves and weaners.

**Source**


**Further information**


**Related topics**

Animal Welfare, Dehorning, Tetanus.
Pregnancy Testing

Kieren McCosker and Neil MacDonald, DoR Katherine

The average gestation length for cattle is 282 days (approximately nine months) with a range of 274–291 days. The two methods used for detecting and aging pregnancies are rectal palpation and ultrasonography. The most affordable and practical method of pregnancy testing cattle is by rectal palpation (feeling the reproductive tract from the rectum).

Most producers are able to learn this procedure from a 3-day course (CDU NT Rural College), but substantial follow-up practice is required to attain reasonable levels of accuracy and speed. Training by qualified practitioners is highly recommended, rather than self-teaching or being taught by unqualified people. Pregnancy testing is an invasive procedure which could cause distress to the cows and affect their later behaviour in the yards. It is not just a matter of feeling for a calf; other internal organs may be mistaken for a foetus. Careless palpitation can damage early pregnancies, and can induce early calving in late pregnancies.

Reasons for pregnancy testing

The main reason for pregnancy testing is to be able to detect non-pregnant cows. Detection of unproductive females and determining suitability for live export are the main reasons for pregnancy testing. Pregnancy testing of animals for export must be conducted by a registered vet or accredited layperson. Females destined for export or feedlots must be tested and declared not detectably pregnant to ensure that they do not calve on board ships or in feedlots overseas. The NT is unique in accrediting non-veterinarians to carry out this task. Accredited operators are tested on their ability to detect pregnant/non pregnant and have to demonstrate a high level of reliable diagnosis. Cows sold by liveweight may attract a higher price if they have been certified to be not detectably pregnant.

Diseases and management problems affecting the whole herd can be identified much earlier if cattle are pregnancy tested. Low pregnancy rates in a particular mob, for example, might indicate poor bull performance. Poor fertility throughout the whole herd might be caused by an infectious disease or perhaps an inadequate plane of nutrition prior to joining. Checking the stage of pregnancy may assist segregation of cows into different calving groups in order to give them different management.

Diagnosing pregnancy

Experienced operators are able to reliably diagnose pregnancy from two months, and more speculatively from six weeks (in some cases from four weeks). Cows diagnosed as 'empty' may be in early pregnancy, so 'not detectably pregnant' is a better description.

Signs of pregnancy can be divided into two groups: suggestive or definitive signs of pregnancy.

Suggestive signs

- a change in the size and location of the reproductive tract
- the presence of a mature corpus luteum
- detection of fluid in the uterine lumen (fluidum)
- enlargement of the middle uterine artery and fremitus
- detection of a heavy cervix when attempts are made to lift it.
Definitive sign
• palpation of the chorioallantois using the foetal membrane slip technique
• palpation of the amniotic vesicle
• palpation of placentomes
• palpation of the foetus.

Characteristics of a non-pregnant tract
• absence of fluid filling in both uterine horns
• both horns of the uterus having a thick, meat-like consistency
• both horns of the uterus being tapered terminally
• both horns of the uterus being slightly coiled and the ovaries easily located by following them in a reverse ram’s horn direction.

Determining stage of pregnancy

Experienced operators aim to determine the stage of pregnancy to the nearest month. Early pregnancies (2–4 months) are harder to detect but can be aged accurately. Well advanced pregnancies (6–9 months) are easy to detect but more difficult to age accurately.

Operators use a range of indicators to determine and age pregnancy (Table 1). Early pregnancy is determined from changes in the size and texture of the horns of the uterus. As the foetus grows, the reproductive tract descends further into the abdominal cavity. From 2.5 months, the cotyledons (attachment points between the maternal and foetal blood supplies) become detectable. These grow and change shape throughout pregnancy and form a key indicator. The weight of the reproductive tract increases as the foetus grows and descends into the abdomen, until by five months the foetus is far forward, often out of reach. After six months the size of the foetus brings it back into reach again. Another indicator used to confirm late pregnancies is fremitus, a distinctive buzzing in the arteries supplying blood to the uterus. In the last trimester, the pregnancy becomes increasingly difficult to age precisely. There is often not room for the operator’s hand to clearly feel the size of the foetus, and there are natural variations in calf size and calving time.
<table>
<thead>
<tr>
<th>Months pregnant</th>
<th>Membrane slip</th>
<th>Amniotic vesicle (relative size)</th>
<th>Foetus</th>
<th>Foetal head size crown</th>
<th>Middle uterine artery</th>
<th>Cotyledons</th>
<th>Uterine character</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+</td>
<td>½ finger</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slight enlargement</td>
</tr>
<tr>
<td>1.5</td>
<td>+</td>
<td>1 finger</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>slight enlargement of uterus with thinning of uterine wall</td>
</tr>
<tr>
<td>2</td>
<td>+</td>
<td>&gt;4 fingers</td>
<td>Mouse size</td>
<td></td>
<td></td>
<td></td>
<td>pregnant uterine horn full with fluid and non-pregnant horn filling</td>
</tr>
<tr>
<td>2.5</td>
<td>+</td>
<td>&gt;Hand and thumb</td>
<td>1 finger</td>
<td></td>
<td></td>
<td></td>
<td>both uterine horns full with fluid and descending into abdomen (8–12 cm)</td>
</tr>
<tr>
<td>3</td>
<td>+</td>
<td>Rat</td>
<td>3 fingers</td>
<td></td>
<td>Upper 0.5 cm; strong pulse</td>
<td>1–1.5 cm (&lt; 5 cents)</td>
<td>12–16 cm</td>
</tr>
<tr>
<td>3.5</td>
<td></td>
<td></td>
<td>4 fingers</td>
<td></td>
<td></td>
<td></td>
<td>14–20 cm</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Kitten size</td>
<td>Hand and thumb</td>
<td>Up to 0.5 cm; strong pulse</td>
<td>1.5–2.5 cm (5–10 cents)</td>
<td>&gt; 20 cm unable to retract</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Large cat</td>
<td>0.6–0.8 cm; fremitus preg side</td>
<td>2.5–4 cm (50 cents)</td>
<td>uterus well down right of midline, may be out of reach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Small dog</td>
<td>Approx. 1 cm; fremitus preg side</td>
<td>4–5 cm (bantam egg)</td>
<td>uterus well down right of midline, foetus may be out of reach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Medium dog</td>
<td>1.2–1.5 cm; fremitus both sides</td>
<td>5–7.5 cm (chicken egg)</td>
<td>foetus begins to ascend</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Large dog</td>
<td>1.4–1.7 cm; strong fremitus both sides</td>
<td>6–9 cm (duck egg)</td>
<td>foetus continues to ascend</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Calf</td>
<td>1.5–1.9 cm; very strong fremitus both sides</td>
<td>8–12 cm</td>
<td>udder bagging</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter Four: Cattle Management

Recommended guidelines for timing of pregnancy testing

**Heifers:** Manual palpation: Minimum 7–8 weeks after last day of mating. Conducting pregnancy diagnosis at the correct time enables culling of infertile heifers before they consume valuable pasture. Significant numbers of heifers should be joined so those that don’t conceive can be culled at the time of pregnancy testing.

**Mature Cows:** Pregnancy testing of cows is generally most convenient at weaning. In controlled mating situations pregnancy testing is conducted 50 days after last day of mating at the latest.

**Accreditation**

Pregnancy testing of export cattle must be undertaken by a registered veterinarian or accredited pregnancy tester.

The Northern Territory Government will accredit competent non-veterinary pregnancy testers. Competency is assessed by CDU Rural Campus, Katherine, based on recognised prior learning or training, and a theory examination and practical test. The assessment can be done on scheduled dates at CDU Mataranka Station or on a commercial station by prior arrangement.

Accreditation lasts for three years and maintenance relies on ongoing pregnancy testing activity, an average of at least 500hd/year.

AQIS require the tester’s accreditation number on declaration forms for export relating to pregnancy status.

**Gaining experience**

After successful training, people will be able to diagnose and age pregnancy in most cows reasonably accurately. Substantial follow-up practice is required to become fast enough to operate on a commercial station. A good operator can test at 500–1000 head per day (50–100 per hour) without losing accuracy. This requires considerable practice, often acquired over several years and testing several thousand head per year. It is important to remember that accurate diagnosis depends on checking several factors, not just one. Also the reproductive tracts of cows vary considerably because of differences in age, body size, calving history and other factors. Beginners who rush make mistakes.

Beginners working slowly find it difficult to get sufficient opportunity to practise, and as a result many do not end up using their pregnancy testing training.

**SUMMARY OF BEST PRACTICE**

- Learn the basic pregnancy testing skills in a 3-day course run by CDU at the Katherine Campus.
- Teaching yourself or learning from an unqualified person is not recommended and can be harmful to cows.
- Practise to become competent and fast.
- Use only registered vets or accredited laypersons to certify non-pregnant cows for export.
- Use pregnancy diagnosis to select, cull and manage breeders.

**Sources**


**Further information**

Charles Darwin University, Rural Campus, Katherine, Ph: (08) 8973 8311.

**Related topics**

Artificial Insemination, Culling Breeders, Heifer Management, Mating Systems.
Spaying

Kieren McCosker, DoR Katherine and Jessica Mayes, formerly DPIFM Katherine

Spaying (also known as ovariecctomy) is the surgical removal of the ovaries. It is often used in northern Australia in extensive beef cattle herds as a contraceptive method when control of bulls is difficult. Spaying to avoid pregnancy is an important way of guaranteeing survival and value-adding to cull females. This is particularly important for export markets.

Spaying is a skilled technique. These notes are not in any way an adequate basis for learning to spay, and are not intended for that purpose.

The two main methods of spaying used in the Northern Territory are the Willis Dropped Ovary Technique and flank spaying. Flank spaying is no longer recommended except where practiced by an experienced veterinarian. The Willis Dropped Ovary Technique is therefore the only technique discussed in detail here. It is a regulatory requirement under the Livestock Act 2008 that all spayed cattle are earmarked with a circular earmark.

Willis Dropped Ovary Technique

The Willis method has been widely adopted in northern Australia since its introduction in 1997, particularly in heifers. It is known as the ‘dropped ovary’ technique because when the ovaries are cut off by the ovariotome they drop inside the abdomen.

The ovariotome, a stainless steel rod about 48 cm long and 6 mm in diameter, is introduced into the vagina and placed against the vaginal wall above the cervix (Figure 1). The operator then inserts a gloved arm in the rectum to manipulate the reproductive tract. The vaginal wall is then pierced with the spearhead end and the ovariotome passed into the abdomen. Each ovary is then manipulated per rectum and placed into the oval hole of the ovariotome. The ovaries are cut off by pulling back on the ovariotome which draws the ovaries into the cutting slot. The Australian Cattle Veterinarians have produced a manual on this technique.

Figure 1. Inserting ovariotome into vulva

Benefits of the Willis method include:

- Speed, quicker than other surgical spaying methods.
- Reduced risk of mortality in non-pregnant cattle.
- The procedure can be done in a standard crush.
- Shorter convalescence.
- No hide damage.
Selecting cattle for spaying using the Willis method

Females to consider for spaying are surplus lactating cows and heifers. Surplus dry cows are usually already in marketable condition and do not need to be spayed. De Witte, Jubb and Letchford (2006) suggest the following factors be considered when selecting females to be spayed.

Animal size

Minimum size of animals depends on the size of the operator’s hand and forearm relative to the size of the animal’s anus and rectum. A liveweight of 180 kg is the recommended lower limit.

Body condition

Although females in poor condition can be Willis spayed, there are a number of reasons why it is better to wait until the body condition score has improved before performing the procedure.

Animals in poor condition:

• are prone to pneumorectum (sucking air into the rectum) which increases the difficulty and risks associated with the procedure
• may be suffering anaemia from internal or external parasites, and so may have a higher mortality rate after spaying.

Time since calving

Recently calved cows should not be spayed using the Willis method. It is recommended that spaying not be done using this technique until four weeks after birth.

Stage of pregnancy

Early pregnant animals, up to about three months gestation, can be spayed.

Feed and water

It is not necessary to have a water curfew before spaying. A 12-hour feed curfew reduces rumen fill and assists with the performance of the operation. Water should be made readily available and easily accessible for at least 10 days following procedure.

Time of year

In hotter times, females should be spayed in the early morning or late afternoon. Plan to spay as many females as possible at the first-round muster. Heavy tick burdens and dehorning the animal at around the same time, particularly in the late dry season, may result in severe stress to the animal and increase the risk of mortalities.

Flank spaying

The flank spaying method is suitable for use on pregnant cows (webbed) or heifers that are too small for Willis spaying. When performed by experienced veterinarians, there is no evidence of worse outcomes from flank spaying than the Willis method.

Chemical spaying

There is considerable interest, particularly from remote areas, for producers to be able to spay cows with a simple vaccination or implant. This is technically possible. Products have been developed, but have not been released because they are not commercially viable. There appears to be no prospect of these products being released in the near future.

SUMMARY OF BEST PRACTICE

• The Willis method is most acceptable.
• Animals should not be stressed before, during or after spaying.
• A water curfew is not necessary before spaying.
• A 12-hour feed curfew reduces rumen fill and assists with the operation.
• Following spaying water should be readily available.
• Concurrent spaying and dehorning is not recommended. Animals recently dehorned, carrying heavy cattle tick burdens, or weak or emaciated should be allowed to recover before spaying.
• Effective restraint in a cattle crush must be used for the safety of animal and operator.
• Spaying must not be performed under extreme environmental conditions of heat, cold or rain.
• Hygienic techniques must be employed.
• Spayed cattle should be allowed to settle on to feed and water in the yards for several hours after spaying, before returning to a paddock.
• Spayed cattle should be monitored and not droved for long distances.
• Three weeks after Willis spaying (or six weeks after flank spaying), animals are considered sufficiently recovered for sale and long-distance transport.

Sources


Further information

The Dropped Ovary Technique for Spaying Cattle – A Training Manual. Contact: Australian Cattle Veterinarians Ph: (07) 3423 1799 or Email: acv@ava.com.au for a copy.

Related topics

Animal Welfare, Culling Breeders, Heifer Management.
Hormonal Growth Promotants

Neil MacDonald, DoR Katherine and Barry Lemcke, DoR Darwin

Hormonal Growth Promotants (HGPs) are slow-release implants containing steroids that can increase growth rates, improve feed efficiency and alter carcass composition in cattle. The aim of HGP use is to enable stock to reach market specifications at a younger age. Growth promotants are particularly effective for steers, as they act in a similar way to the bull’s natural hormone systems removed by castration.

HGPs can be expected to boost growth rates by an average of 0.1 kg/day provided implantation coincides with a period of adequate nutrition and expected weight gain. Administering HGPs to cattle that are losing weight is of little or no benefit. Nutrition determines the level of response to HGP implants, so it is important to take seasons into consideration when planning the timing and length of HGP application.

While a significant number of producers choose not to use hormones for marketing reasons or as a matter of personal choice, HGPs remain one of the simplest ways of increasing production and herd profits. Most companies and many private producers implant steers from weaning, and almost all animals will also be implanted if they enter a feedlot finishing stage.

A 10% increase in growth rate from HGP use may allow turnoff at a target weight at the end of the growing season that may not be possible with untreated cattle.

**HGP variations**

There are two broad types of hormones: oestrogens (female hormones) and androgens (male hormones).

Oestrogen-based HGPs stimulate the pituitary gland to release more of the animals’ own growth hormones, resulting in increased feed intake and weight gain. The main oestrogenic compounds are oestradiol and zeranol. Common commercial oestrogen-based HGPs are Compudose®, Synovex®S and Ralgro®.

The main androgenic compounds are testosterone and trenbolone acetate. Androgen-based HGPs stimulate the production of body tissue by direct action on the cells, improving feed efficiency and promoting the production of lean meat. Androgens are rarely used alone. Androgen-based HGPs usually contain a combination of an oestrogen and an androgen (oestradiol and trenbolone acetate). Common commercial products are Revalor® G, Revalor® S and Synovex® Plus. Under the pastoral conditions of northern Australia, steers with a single implant containing only an androgen are unlikely to exhibit accelerated growth.

**HGP application**

HGPs products are available in different preparations, with different periods of efficacy (e.g. Compudose® 100, 200 and 400 day). Some producers implant weaner steers at the first-round with a 400 day product so the weaners will not need any further treatment prior to being sold. Release of the hormone is not constant throughout the implant’s life, but tends to reduce in time. The implant’s most effective period will be wasted on weaners treated in the middle of the dry season because they are unlikely to be growing enough to benefit from the hormones. Implantation with a 200 day product at a second-round muster is more effective.
Recent research by CSIRO has shown that repeated implantation can be effective with only a slight reduction in the hormone’s efficacy. For producers with small paddocks who can bring their cattle in regularly, maximum production may be gained by more frequent implantations with perhaps a 100 day product.

**Side effects**

HGP are not recommended for breeding animals. In particular, androgens may reduce reproductive ability in females. In males, side effects from HGP implants, especially androgens, include high tail carriage, pizzle prolapse, secondary sexual characteristics, and may influence future reproductive ability.

The animal’s response to HGP implants will usually result in a greater percentage of muscle rather than intramuscular fat or marbling. This may result in a carcase that is less tender than that of an HGP-free animal, but will provide a better lean meat yield. The Beef CRC has found that HGP cause toughening of the premium cuts in the carcase and the carcase will drop approximately two points in the MSA grading system.

**Market restrictions**

Animals implanted with HGP are not eligible for European Union markets and other selected premium markets.

**Producer obligations**

Producers must:

- sign a declaration when HGP are purchased from a retailer indicating the property on which they are to be used
- permanently identify all stock treated with HGP with a 20 mm equilateral triangle ear mark in either ear.
- keep records of HGP purchased and used including batch number and wastage
- keep records of treated stock purchased and sold including origin and destination.

**Identifying cattle implanted with HGP**

All cattle treated with a HGP must be identified with a triangular ear notch. Market access in other states may require the completion of a National Vendor Declaration (NVD) which includes a declaration to identify whether cattle have been treated with HGP. For mixed consignments, separate NVDs may be required. Although individual animal identification with NLIS has eliminated the need for tail tags, some states still require pink or green tail tags to declare that cattle are free of HGP.

**SUMMARY OF BEST PRACTICE**

- Sign the HGP declaration form at retail outlet.
- Identify HGP treated stock with the triangle ear mark.
- Record all HGP purchases, batch numbers, use and wastage.
- Record treated stock purchased or sold.
- Keep breeding stock free of HGP.
- Treat cattle with HGP implants of appropriate length of efficacy at the best time to take advantage of growing conditions.
- Be aware of potential markets. Only use HGP if the market accepts their use.

**Sources**


**Related topics**

NLIS, Weaning.
**Livestock Movements**

Sharon Kearney, DoR Darwin

In the Northern Territory livestock owners must adhere to the required identification and movement requirements of the *Livestock Act and Regulations*. Livestock include cattle, buffalo, goats, sheep, deer, camels, alpacas, llamas and pigs.

The NT uses three systems for identification and movement recording of cattle. They are the brands system, the waybill system and the National Livestock Identification System (NLIS). These three systems can play an important role in disease control and chemical residue traceback programs. This is important to both consumers and producers to maintain confidence in the safety and integrity of Australia’s livestock and livestock products.

**Waybills (Including Health certificate/Waybills)**

The waybill is used to record the movements of livestock in the NT and their use is compulsory under the *Livestock Act*. A waybill provides detailed information which can be used for tracing animal movements. The waybill has a number of other benefits such as a deterrent to stock theft, provides certification of the property of origin for abattoirs and export markets and provides documentation for station management.

A copy of each waybill must be retained by the owner of the stock (green copy), the company or the person taking delivery of the stock (white copy) and the Chief Inspector of Stock (pink copy).

A waybill is required whenever stock are moved outside the boundaries of a property. A waybill is required for cattle, buffalo, sheep, pigs, goats, camels, alpacas and llamas. Horses do not require a waybill, however horses moving from a tick infested area to tick free areas require a permit issued by a Regional Livestock Biosecurity Officer.

When filling out a waybill **ALL** sections of the waybill must be completed accurately by the owner and truck driver.

Livestock from interstate that are entering the NT require health certification and/or tests and treatment to prevent the introduction of serious diseases such as Johne’s disease and acaricide-resistant ticks from other parts of Australia. A Health Certificate and Waybill is issued by the Biosecurity Officer in the state of origin who confirms that the health status of the livestock is acceptable for entering the NT.

**Branding**

Refer to Chapter four – Cattle Management, section 8 – Branding.

**NLIS**

Refer to Chapter four – Cattle Management, section 9 – NLIS.

**SUMMARY OF BEST PRACTICE**

- Use of Waybills, NLIS and Brands are mandatory in the NT for cattle.
- Livestock entering the NT require an NT Health Certificate/Waybill.

**Sources**


Small K and Kearney S. *Health Certificates and Waybills for cattle entering the NT*, DoR, Darwin.


**Further information**

Regional Livestock Biosecurity Officer, Darwin, Ph: (08) 8999 2030.

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**Related topics**

Branding, NLIS, Transporting Cattle – Pre-transport Management.
Transporting Cattle – Pre-transport Management

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Transport is acknowledged as one of the most traumatic events in a domestic animal’s life. Management of livestock prior to transport has a large impact on how well they will travel. Stress during transport has been linked to decreased meat quality, increased levels of sickness and decreased productivity (e.g. increased shrinkage). It is therefore in a producer’s best interest to ensure that stress is minimised wherever possible.

The National Animal Welfare Standards and Guidelines for the Land Transport of Livestock set out the minimum acceptable standards and recommended guidelines for transport of livestock. All people involved with livestock and livestock transport should be familiar with these regulatory requirements.

**Communication with driver**

Ensure that you let the driver know the following:

- where and when to load
- where cattle are going
- type (breed and class) and number of cattle to load
- fitness/condition of cattle (including pregnancy status)
- road conditions
- expected weather conditions
- how long the cattle have been off water and feed
- how cattle have travelled in the past.

**Loading facilities**

Loading is one of the more stressful events of the transport process, and the quality of the facilities can have a big influence on this. It is the responsibility of the producer to provide adequate and well-maintained holding and loading facilities. This includes ensuring no protrusions or sharp edges exist which may cause injury, and the provision of ramps that meet minimum design standards. This will enable trucks to align correctly, and for cattle to load/unload more efficiently.

The minimum standards as recommended by the Queensland Department of Primary Industry and Fisheries for single deck loading ramps for cattle are:

- floor height maximum 1200 mm
- loading ramp width 760 mm
- unloading ramp width 3000 mm
- ramp sides height 1800 mm
- catwalks 800–900 mm
- platform at least 1500 mm long (flat area at the top of the ramp)
- sliding gates at the top and bottom of the loading ramp.

For more information on single and double deck loading ramp design refer to the QDPI&F Note ‘Cattle transport: minimum design standards for loading ramps’.

**Mustering**

Mustering should be carried out quietly and carefully to avoid undue stress to the animal. Cattle require time to settle after mustering, particularly after a difficult yard up or in adverse weather conditions. The Australian Model Code of Practice for the Welfare of Animals states that a rest period after mustering and handling of at least 12 hours is essential before transport. Experienced truck drivers observe that spelled cattle always travel better.
Curfew

Keeping cattle off water and green feed 6-12 hours prior to transport helps to improve the transport process for livestock. Cattle that are not fasted will defecate and urinate more, creating a slippery surface regardless of the crate floor. This leads to more animals slipping and going down on the journey. Research has shown that loss of balance and falling significantly increase stress during transport (Swanson & Morrow-Tesch, 2001). Ferguson and Fisher (2008) found that “Pre-transport curfews (period of enforced food and/or water deprivation) are applied to primarily reduce the gastrointestinal volume prior to transport, thus reducing the total amount of excreta in trucks and the level of faecal soiling on animals. Livestock transporters also advocate that curfews enable animals to cope better with the demands of transport. From the two studies conducted, pre-transport curfews neither enhanced nor compromised the capacity of animals to cope with transport. The period of curfew was merely additive in terms of the total time off feed and water. The need for pre-transport curfews should be predicated on consideration of key factors such as the nutritional background and condition of the cattle and sheep and the duration of the transport as well as the potential impacts on food safety. The research outputs have and will continue to have industry impact in the development of animal welfare standards pertaining to livestock transport and defense of these standards in the future.”

Loading densities

Loading cattle too light or too heavy results in diminished welfare of the stock. Cattle need enough room to regain their feet if they go down. They also need to be in close enough contact with other animals to mutually support each other. Research has shown that cattle transported at higher than recommended stocking densities have elevated levels of stress, bruising and go down more. The losses attributable to overloading far outweigh the gains of a few saved dollars in transport costs, particularly if a beast dies in transit.

The person best able to determine the appropriate loading rate will be an experienced driver, who has trucked thousands of cattle, and witnessed how cattle travel. A guide to loading densities is shown in Figures 1–3.

Shrinkage rates

Feed and water curfews, in combination with transport, can result in significant weight loss, mainly through loss of body fluid and gut contents. On average cattle will lose 8% body weight over 1000 km, but much lower or higher rates do occur. The length of time that cattle are deprived of feed and water is the single greatest factor in determining the degree of shrink experienced. However, cattle can lose more weight in hotter weather, if they are of poor temperament or are stressed. The effectiveness of electrolytes in reducing dehydration and weight loss (pre- and post-transport), while best practice in some places, is questionable. Few producers in the Top End region administer electrolytes pre-transport.

More recently, research suggests that a pre-transport novel oral supplement (osmolyte glycerol) could reduce loss of body water, assist in delaying effects of dehydration, aid preservation of carcase protein and quality and boost the immune system (MLA 2005).

Shrinkage rates will be less when:

- all stressors are minimised
- cattle have had time to settle after muster and yard procedures, e.g. pregnancy testing, drafting
- cattle are of quiet temperament.
Look after the drivers

Transporting cattle is not an easy business, with drivers often travelling a long way to get to the loading point, and having a long way to go before cattle are unloaded. Remember, a truck travels slowly on rough roads. It is a matter of courtesy for the producer to have everything right to go when the trucks arrive and with increased focus on fatigue management policy for drivers, producers have a role to play in ensuring drivers are able to maximise their driving time for the benefit of themselves and the industry.

A few points to note:

• a driver should not be expected to work in the back yards and isn’t covered by workers compensation if he gets hurt
• cattle should be drafted and ready to load when trucks arrive
• ask if drivers need a hand to load and how you can best be of assistance
• offer drivers a shower and a feed
• ensure the relevant paper work is filled out correctly and supplied to the driver
• consider driver fatigue and the trip length when planning when to load cattle.

Sources


Further information


Related topics

Animal Welfare, NLIS, Cattle Yard Design.