

Weaner throughput

Key actions

- Assess the fertility and fecundity of your herd using cow condition score and heifer liveweight within the confines of a limited joining period.
- Select cows capable of conceiving within two mating cycles to maintain a 365-day calving interval.
- Select healthy, fertile bulls for mating to achieve normal conception rates and a condensed calving pattern.
- Supervise calving, particularly of heifers, to increase live calves born.
- After weaning, cull all cows who required intensive calving assistance or failed to rear a calf.
- Use age, weight and condition score of cows as indicators for earlier weaning.
- Aim to wean calves when the efficiency of pasture use is greater for the calf alone than for the cow–calf combination.
- Use yard weaning to lift cattle productivity.
- Use higher heifer retention rates to increase selection pressure on cow herd.

Why is maximising weaner throughput important?

Increasing the number of cattle sold each year has a major impact on the profitability of southern beef enterprises. Sales from a beef business include stock bred on the property, cull cows and any purchased trading stock.

Increase throughput to increase profit

The two main components of weaner throughput are:

- total product from the enterprise (number of weaners, saleable product in kilograms)
- stocking rate (discussed in **Module 1: Setting directions**, **Module 2: Pasture growth**, and **Module 3: Pasture utilisation**).

The cow culling policy generates a significant financial return for southern beef enterprises. Higher heifer retention rates allow much greater culling pressure on poor maternal females

Fecundity (number of live calves per breeding female) is not discussed in this module, despite its potential impact on the throughput of weaners and saleable product. There are currently no commercially viable means to increase twinning in Australian commercial beef herds and, unless a high proportion of the herd has twins, the costs involved will not warrant adoption of a high-fecundity strategy.



How does this module assist you?

This module will help you:

- increase the throughput of weaners bred on your property.
- manage your culling strategy for weaner heifers and mature cows
- understand that nutrition drives fertility, and that the allocation of energy to maintenance, growth and reproduction (in that order) is the limiting factor
- recognise the biological constraints imposed on different stock classes, and understand the reallocation of a limiting resources (eg feed) to the most sensitive stock, such as reproductive heifers and growing stock.

The information in this module will help you to manage selected animals prior to mating and right through to the weaning stage.

Linkages to other modules

The throughput of animals is also linked with issues discussed in **Module 1: Setting directions**, **Module 3: Pasture utilisation** and **Module 7: Meeting market specifications**.

Post-weaning management of progeny and the treatment of cull animals are incorporated into **Module 7: Meeting market specifications**. Genetic improvement of fertility, mothering ability and growth are discussed in **Module 4: Cattle genetics**.

The management of common reproductive diseases that infect beef herds is outlined in **Module 6: Herd health and welfare**.

Principles of maximising weaner throughput

- Manage the herd to maximise fertility and weaner throughput.
- Manage livestock feed consumption and better allocate high quality pasture to maximise reproductive function and turn-off of sale cattle.



- Minimise the total consumption of pasture by the breeding herd to fulfil biological function, while ensuring cows and calves have access to sufficient quality and quantity of pasture to maximise throughput.
- Manage weaner cattle post-yard weaning to achieve target growth rates by manipulating feed allocation to ensure future performance.

Procedures for maximising weaner throughput

- Procedure 1 – Maximise live calves
- Procedure 2 – Control mating period
- Procedure 3 – Wean early
- Procedure 4 – Female culling and replacement policy

Procedure 1

Maximise the number of live calves per breeding female

Manage cows and heifers for high fertility to maximise the lives calves per breeding female.

Guidelines for managing cows to achieve high fertility

Profitability in beef production is driven by high stocking rate and high herd fertility, which are both a function of high feed quality and quantity (dry matter production).

Fertility

In a fertile herd, 70% of exposed females will be cycling, exhibiting oestrus and becoming pregnant in the first oestrous cycle; more than 95% will be pregnant at the end of the second oestrous cycle (ie after 6 weeks).

The basic components of herd fertility are:

- calving heifers at two years old
- high pregnancy rates in all age groups
- a short calving span
- a concentrated calving pattern within span
- minimising dystocia losses in two-year-old heifers
- getting first-calvers back in calf quickly.

Nutrition

Nutrition is the key to understanding what really drives efficient reproduction. Nutrition influences the onset of puberty in heifers, and the ability to exhibit oestrus and get in calf quickly, either as heifers or return to oestrus post-calving in first calf heifers.

The key indicators of reproductive performance are body condition score for cows and liveweight for heifers.

Adequate nutrition (principally energy) over and above maintenance and growth requirements is required to drive the onset of oestrus, both in young growing heifers and older cows. Older cattle that have no growth requirements can allocate more energy to reproductive processes than rapidly growing heifers, who have high energy and protein requirements for growth.

The energy intake for pregnant heifers must always be adequate to maintain growth for herself, and for the developing gravid uterus. This requirement has been quoted as being around 40MJ for maintenance and 34MJ for each kilogram of body weight gained by the heifer in the growing stage to the point of calving. The developing foetus requires an extra 5MJ/day for the first five months pregnancy, 8MJ/day at six months pregnancy, 11MJ/day at seven months, 15MJ/day at eight months and 20MJ/day at nine months pregnancy.

Table 1: Energy (MJ) requirements for different livestock classes

Breeder cows	350kg	400kg	450kg	500kg	550kg	Protein required
Dry cow	48	52	57	61	66	6%
Pregnant, last 3 months	60	65	69	74	78	6%
Lactating cow and calf, 0–3 months	74	80	85	90	95	10–11%
Lactating cow and 150kg calf (using DSE ratings in PROGRAZE)	111	118	125	133	140	10–11%
Growing cattle	150kg	200kg	300kg	400kg	500kg	Protein required
Maintenance	22	26	35	45	55	8%
Gaining 0.5kg/day	37	44	57	71	82	10–12%

Gaining 1.0kg/day	50	59	76	93	108	13%
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Older cattle may have body reserves that can be used in times of energy deficit. The loss of 1kg of body weight will release around 29MJ of energy that can be allocated to the reproductive process over and above what has been consumed.

Controlled weight loss at certain times of the year is acceptable, as long as it does not impinge on biological function. For older cows, body condition score may fall as much as 1.5 units, say from condition score 4.0 in late spring after they have grazed the spring flush to a condition score 2.5 by winter. This equates to a 110kg weight loss, or a release of 3,000MJ of energy from fat without any undue side effects, if done correctly. The ability to 'mine' the body condition of cows is a great tool in shifting the pasture curve, but it requires careful management not to exceed the biological constraints and impinge on reproductive ability.

This explains why body condition score is an important factor in determining return to oestrus if feed consumed daily is not meeting total energy requirements.

Conversely, even when body condition score may appear inadequate, if high quality feed is on offer – over and above that required for growth and maintenance – adequate energy can be redirected to the reproductive process.

Body condition score is a retrospective measure, and current feed conditions must also be considered.

It is more accurate to calculate daily intake (MJ consumed) and match this to daily energy requirements (MJ required) of a particular stock class to achieve a predetermined outcome. This also allows proactive management of risk when feed is limiting.

Guidelines for heifer management and nutrition

Management for joining first-calf heifers and their subsequent performance is entirely governed by controlling the body weight from pre-weaning through post-weaning to joining, and then from joining to calving.

Onset of puberty

Puberty is a function of both genetic makeup and biological constraints. Of the biological constraints, nutrition, body weight and age play a greater role in determining the onset of puberty than age alone.

Table 2 demonstrates that by increasing growth rate through good nutrition, puberty is reached earlier and faster, but at the same weight as the slow growing heifers. That is to say, fast growing Holstein heifers reach puberty at the same liveweight as slow growing heifers.

Table 2: Relationship between nutrition and puberty in heifers

Growth rates	Daily gain to puberty	Age at puberty	Weight at puberty	% of mature weight at puberty
Slow	0.41	20.2	289	43
Medium	0.67	11.2	265	39
Fast	0.72	9.2	278	40

In beef breeds, puberty occurs when heifers reach about 52% of mature body weight. The recommended critical mating weight is 55–60% of mature body weight but this varies depends on frame score and individual breed.

Table 3: Relationship between liveweight and puberty in Hereford and Angus heifers

	Age at puberty	Weight
Hereford	13.9 months	285kg
Angus	12.8 months	270kg

Critical mating weight (CMW) for heifers

Adopting the concept of a target weight for joining that exceeds the weight required for the onset of puberty will ensure that all heifers are actively cycling and fully fertile when exposed to a bull. A target of 65–70% is easily achievable and will ensure that the maximum number of heifers conceive in the first oestrus cycle during the joining period. This will also create a concentrated calving pattern over a short timeframe, an even drop of calves and, most importantly for the calved heifer, a better chance of returning to oestrus to maintain a 365-day calving interval.

Management of heifers from weaning to joining to reach critical mating weight (CMW)

Critical mating weight is defined as the weight at which 85% of heifers fall pregnant over 45 days (two cycles).

- Weigh heifers every 6 weeks after weaning to stay on growth targets.
- Use supplementary feed to attain growth (as a guide, feed 1% body weight in silage, hay or grain to supplement pasture).
- Formulate feeding strategies well in advance of joining to reach critical mating weight.
- Practice good parasite control at weaning (an often neglected aspect) using an effective drench, and drench again 3–4 weeks prior to joining.
- Ensure all heifers are cycling in unison before mating because fertility at first oestrus is 21% lower than at third oestrus.
- Supplement with selenium to improve reproductive efficiency and achieve high conception rates, if deficient.
- Maximise the number of heifers reaching critical mating weight 2–3 cycles before joining.

Importance of a tight calving span in heifers and cows

How a heifer calves in her first gestation in relation to the herd calving span determines the relationship of that cow to the herd for the rest of her life. Heifers who calve early in the calving season will continue to do so for the rest of their life.

Tight calving spans allow even calf drops, even lines of saleable cattle, better management, better use of labour and a herd that consistently reproduces within a 365-day timeframe.

In two studies, early calving heifers had, on average, weaned calves for the rest of their lives that were 13kg heavier than their herd mates who calved in cycles 3-4 as heifers.

Trial results

Influence of calving date on subsequent fertility

- Cows that calved in the first 44 days had subsequent fertility of 91%.
- Cows that calved in the next 30 days had subsequent fertility of 82%.
- Cows that calved in the next 30 days had subsequent fertility of 71%.

It is critical to continue growing heifers from joining to calving to obtain maximum pelvic size for the calving process.

Heifer condition score and energy intake at calving determines the ability to return to oestrus and maintain a 365-day calving interval.

Cattle that calve in low body score but have good nutrition post-calving (spring calving) will return to oestrus. The problem of low body score at calving is offset to some extent by the increasing plane of nutrition.

Cattle with a low body score at calving and then poor nutrition post-calving will fail to cycle (autumn calving).

Use cow condition score and heifer liveweight as indicators of herd fertility

Guidelines for the minimum and maximum mating values for British breed heifers and cows

Minimum mating values

- For heifers – joining liveweight of 300kg, condition score 3.0 at 15 months of age (see **Tool 5.1** for a guide to minimum joining liveweight).
- For mature cows – condition score 2.5 (see **Tool 5.2**) with increasing plane of nutrition post-calving.
- For first-calf heifers – condition score 3.0.

Maximum mating values

- Condition score 3.5.

If the breeding herd is outside these recommended guidelines:

- increase or decrease pasture available or pasture quality before mating to ensure condition score of cows or liveweight of weaner heifers remains within the recommended limits.
- wean calves when cow condition score falls to 2.5 (trigger threshold) as long as calves are older than 120 days or at minimum 100kg liveweight.
- supplementary feed a high quality diet to cows when condition score is below 2.0.
- supplementary feed heifers if required, with known energy density feed to ensure they reach target weight, and consider including the use of a rumen non-degradable protein source if pasture quality is low (see **Tool 5.1**).
- Assess animal health status, particularly for internal parasites (worms, fluke), and treat if there is a problem as described in **Module 6: Herd health and welfare**.
- Cull weaner heifers that fail to reach target liveweight or conceive within two mating cycles.

Genetics, as reflected through various EBVs, also has a minor role in breeding for herd fertility:

- Selecting sires with a high EBV for scrotal circumference results in earlier onset of puberty in the heifers.
- Days to calving EBV will also help in decreasing the interval between calving and conception by decreasing the gestational length.
- Calving difficulties are reduced by selecting sires with a low score EBV for gestation length.
- Low EBV for birthweight will decrease calf size for that generation but should be used cautiously as most cases of dystocia are a result of a failure to maximise maternal pelvic size through poor nutritional management. Managing nutrition is a far more immediate way to manage calving ease.
- If the phenotype of the herd, especially heifers, is high yielding with a larger mature body size (ie Euro type), they tend to be later maturing with a later onset of oestrus.

Use **Tool 3.5** of Module 3: Pasture Utilisation as the basis for determining how pasture can be successfully turned into animal products to profit the farm business. Strategies in **Module 3: Pasture Utilisation** enable you to more precisely manage the conversion of pasture energy and nutrients to saleable beef product while leaving pasture residue in an optimum condition for rapid regrowth. It also better matches the seasonal feed supply with beef enterprise opportunities and business objectives.

Manage fertility to maintain a calving interval < 365 days

Calving to conception interval

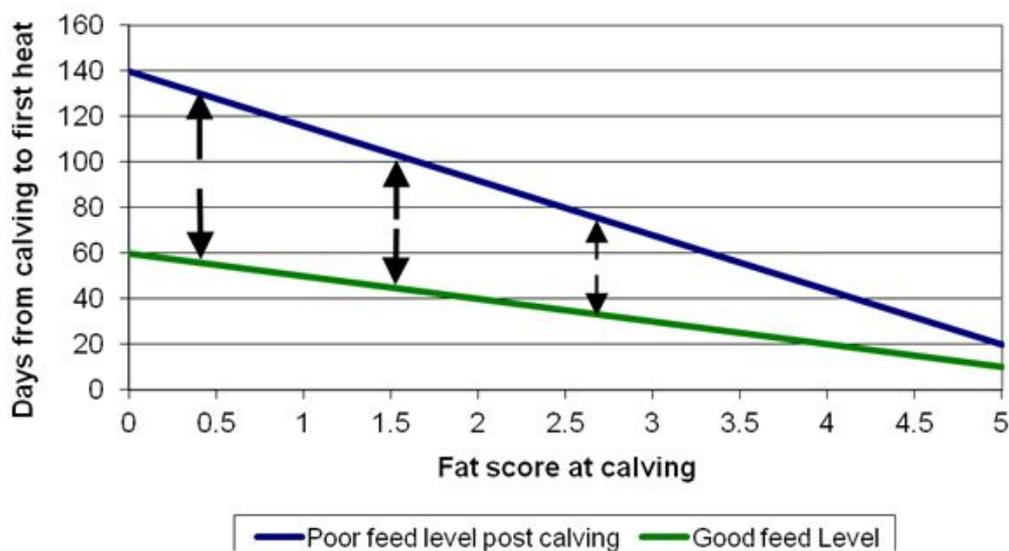
The time between calving and conception has a major impact on the reproductive performance of beef herds and cows must mate by around day 82 after calving if the mean calving time is to remain the same from year-to-year with a 365-day calving interval.

The inability to maintain a 365-day interval will invariably mean a drift in the mean calving date later and as a result the calving histogram will change, more late calves born, more cows fail to join on the next joining and drop out empty. The late drop calves have less growing days to weaning, lighter selling weights and more heifers unable to reach the critical mating weight with less growing days.

There is strong evidence that body weight and particularly body condition score of cows at calving has a substantial effect on the post-partum anoestrus interval. Increases in condition score during late pregnancy through the provision of good nutrition, particularly energy, can reduce the interval between calving and first oestrus for all cows except those in good condition where it has no effect. A similar outcome can be achieved through the provision of good nutrition during early lactation.

The target condition score at calving will depend on the quantity and quality of available pasture after calving and the timing of calving relative to other cows in the herd. Using the Australian cattle condition score system from 0.0 to 5.0, early calving mature cows should have a condition score of 2.0–2.5, late calving cows a score of 3.0–3.5 and early calving first calf cows a score of 2.5–3.0. For cows with a condition score less than that prescribed, the provision during late pregnancy of high quality pasture or supplementary feed is recommended.

Figure 2: Effect fat score at calving has on days to first heat



To increase conception rates, it is important to join females on a rising plane of nutrition.

Table 4: Return to oestrus post-calving

Days after calving	First calf heifers return to oestrus %	Old cows % return to oestrus
40	15%	30%
50	24%	53%
60	47%	72%
70	62%	82%
80	68%	89%
90	79%	94%
100	91%	96%

Source: *Merial Opportunity of a Lifetime*

As Table 4 indicates, the real challenge in maintaining a 365-day calving interval lies with the heifer population. Only 68% of heifers are cycling within the 82-day period required to maintain the calving interval.

Important considerations for calving heifers include:

- first-calf heifers take longer to return to cycling post-calving
- heifers with dystocia take longer to return cycling
- heifers are particularly sensitive to body weight at calving and post-calving nutrition as reflected in slow return to oestrus
- aim for approximately 420–450kg liveweight at calving
- prioritise resources to meet the needs of heifers in the lead up to, and following, calving.

Heifers should be joined 2–3 weeks before the main herd as this allows 2–3 weeks longer to cycle post-calving and slot into the main herd to maintain the tight calving pattern. The downside is that these heifers have 2–3 less growing days to attain critical mating weight pre-joining, which means that monitoring weight gain post-weaning to joining is absolutely critical.

Heifer performance is critical. Underperforming animals are inherently less fertile, can fail to achieve maximum pelvic size leading to dystocia, and can fail to get into calf quickly as second calvers.

The effects of nutrition on reproductive efficiency in older cows is less apparent, and allows reallocation of the limiting factor in production, namely feed, to the younger cattle.

Select cows capable of conceiving within two mating cycles

In seeking to strictly maintain a 365-day calving interval, high culling rates may be required which in turn increases the number of replacement heifers required to maintain the herd breeding structure. This practice results in a higher proportion of quality pasture being used for maintenance of the breeding herd because of the amount of pasture needed to grow females up to first mating. However, the benefits of higher heifer retention rates far outweigh the perceived downside of having to allocate quality feed to breeders.

Purchase of in-calf heifers to maintain herd structure increases the risk of introducing infectious diseases, particularly pestivirus (also known as bovine viral diarrhoea virus or BVDV) or Johne's disease, and if heifers are from an unknown genetic background, they may not be compatible with strategic business and breeding goals. Purchased heifers are also unlikely to match the planned calving period and could have higher rates of dystocia than mature cows.

Biosecurity of individual herds is a serious consideration, and any introduction of outside stock can expose the herd to many animal health issues.

What to measure and when

- Conception rates from natural mating or when an artificial insemination (AI) program is implemented.
- Condition score of cows at regular intervals according to the seasonal conditions – monitor after weaning of the last calves, from 6 weeks before calving, and then from calving to mating.
- Liveweight of weaner heifers every 6 weeks until mating.

The stock manager should also observe the breeding herd for evidence of female activity (cycling) prior to the commencement of mating.

Further information

Further information on supplementary feeding can be found on the websites of state departments of agriculture:

- NSW Department of Primary Industries: www.dpi.nsw.gov.au
- Department of Primary Industries, Victoria: www.dpi.vic.gov.au
- Department of Primary Industries and Regions, SA: www.pir.sa.gov.au
- Department of Agriculture and Food, WA: www.agric.wa.gov.au
- Department of Primary Industries, Parks, Water and Environment, Tasmania: www.dpiwe.tas.gov.au

Management of heifers and cows before calving

Guidelines for managing heifers and cows before calving

Careful management of nutrition of pregnant females in all trimesters of pregnancy pays dividends at calving time. Calf loss will be minimised and calving supervision can be kept to a minimum. Calving difficulties will be reduced by maintaining cows at condition score 3.0 (3.5 for heifers), supplying adequate nutrition from joining to calving to prevent growth restrictions to reaching maximum pelvic size. This requires maintaining a condition score of 3.0–3.5 through to the point of calving.

Manage pre-calving carefully to minimise difficulties at calving

If females go outside these guidelines:

- increase or decrease pasture available or pasture quality before calving to ensure condition score of cows or liveweight of weaner heifers remains within the guidelines. As a guide, manage British breed heifers to gain an average weight gain of 0.6kg/day to a joining liveweight of 300kg, condition score 3.0 at 15 months of age.
- consider supplementary feeding a high quality diet to cows when condition score is below the low 2s.
- consider supplementary feeding heifers, including a protein source rich in rumen non-degradable protein, particularly if pasture is readily available but quality is low. This ensures weaner heifers gain weight at 0.6kg/day to reach target weights at 3, 6 and 9 months post-conception, as defined in **Tool 5.1**.
- assess animal health status, particularly for internal parasites (worms and fluke tend to be a greater problem in younger animals), and correct if there is a problem, as described in **Module 6: Herd health and welfare**.
- achieve a balance required between:
 - overfeeding (heifers in particular) in the last three months of pregnancy, as this will increase birth weight and subsequent dystocia
 - underfeeding in the last trimester of pregnancy, as this will predispose to metabolic disorders like ketosis. Restriction of nutrition in the last trimester can increase dystocia rates, slow uterine contractions at birth, and delay return to oestrus post-calving.

Poor nutritional management of heifers and cows before calving can lead to a number of significant problems, including

- dystocia in heifers, due to inadequate pelvic size for the foetus, and due to over-fatness and uterine inertia in mature cows.
- birthing difficulties, which may lead to stillborn calves, inability of the mother to re-conceive, inability of live calves to thrive, reduced ability of resulting heifer calves to reach target weights at mating, and possibly reduced mature weights as cows.
- predisposition to various metabolic disorders, including milk fever (hypocalcaemia) and ketosis/pregnancy toxaemia (see **Module 6: Herd health and welfare**) due to over- and underfeeding of cows before calving.

What to measure and when

- Condition score of cows every two weeks from 12 weeks before calving.
- Weight and growth of heifers at 3, 6 and 9 months of pregnancy.
- Use **Tool 3.5** of **Module 3: Pasture utilisation** as the basis for successfully matching seasonal pasture supply to the feed requirements of heifers.

Procedure 2

Control the mating period to maintain selected annual calving dates

- Follow guidelines for reducing the spread of calving
- Supervise heifer and twin calving
- Manage bulls for high conception
- Pregnancy diagnosis

Guidelines for reducing the spread of calving

Aim for 95% of cows to calve in a 9-week period

Commercial beef producers who are striving for maximum efficiency should aim for 95% of cows to calve in a 9-week period. This procedure explores the date for removal of bulls or the duration of mating to reduce the spread of calving and to sustain the annual calving date/s. The start of mating is determined in **Module 1: Setting directions**.

The ideal calving distribution should consist of 65–70% of calves dropped in the first 3 weeks (first cycle), followed by 20% in the second 3 weeks and 10% in the third 3 weeks. This level of reproductive efficiency will produce an even line of calves of roughly the same age, making them easier to manage and market.

To achieve the ideal calving distribution, the guidelines for the length of mating are:

- maximum 60 days for bulls run with cows
- minimum 45 days for bulls run with cows (if bulls are not run with the cows for long enough, the calving percentage is decreased).

These recommendations allow all females to complete at least two oestrus cycles during mating. These limits can also be applied strictly for heifers.

When the bulls are run with the cows for too long, the subsequently long calving period results in:

- reduced ability to maintain a 365-day calving interval
- unnecessary increase in the use of high quality pasture by the breeding herd and a reduced available pasture for growing stock
- difficulty obtaining critical mating weight at the nominated mating date for heifers that conceive later in the mating period
- increased heifer culling and difficulty in maintaining desired herd age structure
- increased cost of supervision for calving heifers (and twins)
- wider spread of calf weights that will delay weaning date until the lightest calves reach target weight
- wider spread of weaning weights that can lead to problems, such as calf marking and associated husbandry procedures during less favourable seasonal conditions.

To achieve the recommended mating periods, apply these rules:

Aim for 80% of cows to conceive by end of second oestrus cycle

- Manage mating so that 80% of cows conceive by the end of the second oestrus cycle.
- Remove bulls when the maximum period is reached, providing that the assessment of calving patterns indicates that a 60-day joining is sufficient for a satisfactory pregnancy rate.
- Adopt a strategy to realign the herd's calving pattern when more than 20% of the cows are conceiving on the third oestrus cycle (see 'Changing calving time' box, below).
- Do not use the same bulls in subsequent seasons if the mating histogram shows more than 40% of cows are not conceiving at the first mating. Refer to previous pages on cow fertility (**Procedure 1**) and bull fertility (see below) if this happens.

Take corrective action when > 20% cows conceive in third oestrus cycle

As a guide, if a calving date histogram of the herd (see **Tool 5.4**) in the previous year shows that more than 20% of cows conceived in the third cycle, realign the reproductive capacity and age structure of the herd over several years to avoid economic penalties for the enterprise.

The recommended minimum and maximum number of mating days is based on the assumption that more than 80% of cows conceived by the second oestrus cycle in the previous year's mating. If less than 80% of cows conceived by the end of the second oestrus cycle in the previous year, initiate a program to realign the herd's calving pattern. In this case, the mating period may need to be extended beyond the recommended maximum limit to ensure satisfactory throughput in the short term.

Changing calving time

The calving pattern of cows is very repeatable, and it is difficult to bring the date of calving for late-calving cows forward by more than a 3-week cycle per year without risking an unacceptably high rate of empty cows.

Where it is necessary to move the calving date forward by more than 6 weeks (over two years), it may best to leave the current cow herd in its established calving pattern and join the replacement heifers to calve at the desired calving time and period. As the number of young breeders (calving at the desired time) increases each year, the older, out-of-sequence cows can be culled. After about five years, the herd will be calving at the required time over two heat cycles with minimal risk of low conception rates.

What to measure and when

- Record the date on which each cow calved to develop a 'calving histogram' (see **Tool 5.4**).
- Record the number of days that bulls are with cows.

Ensure that the investment of labour to record information on calving patterns and difficulties benefits the breeding operation.

Mature cows

Mature cows should not need assistance at calving as the cost of labour outweighs the benefits. Aim for cow condition scores of 2.5–3.5 and a minimum of 1,500kg green DM/ha in calving paddocks to minimise weight loss in cows and produce satisfactory milk for calves.

What to measure and when

- Twice-daily routine observations, then two-hourly once a cow is actively engaged in labour.
- Note the number of hours since 'waters have broken', membranes showing, or the cow is actively engaged in labour.

Dystocia

The penalties associated with failure to optimise heifer growth from pre-weaning through to post-weaning and then from joining to first calving are significant, including failure to reach critical mating weight (CMW) and re-conceive, high rates of dystocia and reduced lifetime production.

Around 52% of bovine deaths occur at calving time as a result of dystocia or calf disease from scours and cow losses.

Dystocia is an abnormal or difficult birth or labour, and results from a foetal-pelvic disproportion. Several factors can cause dystocia, including:

- large calf size – a function of genetics of both maternal and paternal traits, as well as varying rates of maternal nutrition from conception through to birth.
- placental size – potentially important; a function of nutrition at conception through to about day 80 of gestation. A positive correlation between placental size and birthweight of the calf is well documented, and excessive nutrition immediately post-joining can influence calf size.

Other more complicated mechanisms are at work, and in some cases, cows under nutritional stress can allocate more nutrition to the foetus at the expense of their body condition via a progesterone pathway, and can produce larger calves as a defence mechanism for calf survival in times of energy deficits.

Generally, excessive rates of dystocia are attributable to failure of the cow to reach adequate pelvic size as a two year old. In most cases, this is a management failure to match the growing heifer's nutritional requirements from pre-weaning to post-weaning and from joining to calving as a two year old.

Losses from dystocia range include:

- failure to raise a calf
- culling the empty cow
- increased labour costs to supervise calving
- increased mortality rates for surviving devitalised calves in the first month of life.

The influence of heifer nutrition on dystocia rates far outweighs the genetic component affecting birthweight and size.

EBVs for birthweight, calving ease, days to calving etc. are useful tools but it is important to consider nutritional influences.

What to do

- Aim for maximum pelvic size

- Ensure the best nutrition for heifers both pre-weaning and post-weaning (the single biggest factor in lowering dystocia loss).

Supervise heifer (and twin) calving

Guidelines to supervising heifer (and twin) calving

Calving difficulties in beef heifers can be a major source of financial loss, causing calf death rates of up to 10%, and in some cases, death of the cow. Other costs associated with calving difficulty include labour for supervision and assistance, veterinary fees and overall reduction of herd fertility.

As a guide, assist at the birth of a calf in the following instances:

Heifers with a single calf

- Maximum of two hours after the 'waters have broken', membranes showing or heifer is actively engaged in labour.

Cows with twin calves

- Supervise calving to increase live calves born.
- Maximum four hours for first calf to be born – after the 'waters have broken', membranes showing or cow is actively engaged in labour.
- Maximum two hours after birth of the first calf and before birth of second calf.

Calve heifers between condition score 2.5 and 3.0, and have them in good physical condition at calving. If the calving of heifers or cows with twins is not carefully supervised, difficulties during the birth process may result in:

- increased number of stillborn calves
- calves failing to thrive
- cows dying or being injured
- retention of foetal membranes (particularly in twin-bearing cows), which could become infected and reduce future fertility
- increased veterinary costs.

Ensure heifers are in good physical condition at calving

When a difficult calving occurs, provide assistance in the birth process to improve the chance of cow and calf survival. It is recommended that heifers or cows bearing single calves that need assistance during calving are culled after their calves have been weaned.

Take action when calving difficulties (dystocia) are a sufficiently large issue (as judged by the percentage of heifers or cows experiencing difficulties), a high percentage of calves are stillborn, or considerable time is required to assist heifers and cows experiencing difficulties.

- Cull any cows that required intensive calving assistance after weaning their calves.
- Include calving ease in the enterprise breeding objective when selecting bulls for mating (see [Module 4: Cattle genetics](#) for information on setting breeding objectives).

Manage bulls for high conception

Guidelines for managing bulls to achieve high conception

Carefully consider the number of bulls allocated to mating groups or herds. Insufficient bulls for the number of cows in a herd can lead to lower pregnancy rates and reduced throughput of animals meeting market specifications.

Use two healthy fertile bulls per 100 cows for normal conception rates

Bulls must be monitored closely during mating.

General guidelines for bull ratios are:

- maximum 2 bulls/100 cows for intensively managed southern herds
- maximum 4 bulls/100 cows for extensive grazing (ie pastoral zone)
- minimum 2 bulls/100 cows or per herd.

Single sire joining is widely practised in the southern beef industry and particular care needs to be taken to achieve high conception rates at every joining. Single bull mating reduces the risk of bull injury from fighting, but increases the potential for low calving percentages within individual mobs due to infertility or sudden loss of service ability. The following guidelines are suggested to reduce the risk.

Take particular care of bulls when single sire mating

- Assess all bulls every year prior to mating, and only use those that meet the assessment guidelines (described in the 'Bull assessment guidelines' section, below).
- Join each bull to a maximum of 50 cows.
- Avoid wasting bull resources; joining sound bulls to less than 40 cows is wasteful and increases the cost of bull purchases.

- Observe all herds weekly during the joining period to ensure that the bull is working and has not been injured during mating.
- Have bulls in reserve (at least 20%) to replace injured bulls as soon as they are identified, and consider extending the joining period in that herd by one week (or the period between observations).

Manage bulls carefully pre-mating to achieve high conception rates

The management of bulls has a large impact on herd reproduction. Bulls with low fertility decrease conception rates, which leads to low pregnancy rates, increased calving spans, reduced throughput of weaners and animals meeting market specifications, and consequently reduced enterprise profits.

Additional costs may be incurred because of:

- the need to replace bulls more often
- the potential spread of infectious diseases that may reduce the fertility of cows and increase enterprise costs through treatment or eradication of the diseases.

Poor bull management can significantly decrease fertility

Common sources of low bull fertility and conception include:

- bulls in poor condition two months prior to mating (when semen is produced)
- insufficient effective bulls for the number of cows in the mating herd
- use of too many bulls, which encourages fighting and is wasteful (but retain a replacement bull)
- mixed ages of bulls in mating groups, or mixing bulls shortly before or during mating, which can affect conception while social dominance is being established
- large mating paddocks where bulls and cows become separated
- over-fat bulls (condition score 4.0–5.0) and unfit bulls due to lack of exercise (over-fatness can interfere with the heat exchange function of the testicles resulting in infertility with low sperm output)
- transporting bulls for some distance or feeding high grain supplements close to the start of mating
- venereal disease (eg vibriosis, trichomoniasis).

Bull condition score

Body condition score is a key factor when monitoring the general health and nutritional well-being of bulls. It is also a means of assessing whether young bulls have been overfed before purchase and may fail semen and serving ability tests.

The ideal condition for a bull prior to mating is condition score 3.0

Aim to keep the condition scores of British breed bulls within the following ranges at start of mating, and then during mating:

- minimum condition score 2.5
- maximum condition score 3.5.

Options for adjusting the condition scores of bulls include:

- checking bull soundness at least two months before the start of mating (allows nutritional adjustments to start with sufficient time to ensure target condition score and testicular size responses are met)
- increasing or decreasing pasture available or pasture quality for bulls before mating
- supplementary feeding with a diet containing at least 11.5MJ/kg when condition score is less than 2.0, and considering protein supplements to stimulate testicular development before mating
- replacing bulls if condition score is below the suggested limit at the start of mating.

Bull physical soundness

Prior to mating, bulls need to be assessed as physically sound, not carrying reproductive infectious diseases and having acceptable levels of libido and semen quality. (See 'Bull assessment guidelines' section, below).

Assess bulls for physical soundness pre-mating

Bull assessment guidelines

Bulls must pass all physical tests specified in the Australian Association of Cattle Veterinarians' publication, *Evaluating and Reporting Bull Fertility*. The physical attributes evaluated include:

- front and hind feet claws and soles
- angle of pasterns in front and hind legs
- hind limb conformation from the side (normal, sickle hocked, post legged, swollen or puffy hocks)
- hind limb conformation from rear (normal, bow legged, cow hocked)
- stance and gait abnormalities
- spine and limb defects

- head examination from front and side for alignment, absence of swellings and normality of eyes
- scrotal skin pliability, thickness and inflammation
- scrotal palpations for fat, freedom of movement, head, body and tail of epididymis, shape of testes, hernias
- prepuce, sheath and umbilicus
- penis, including palpation through skin, protrusion of penis and examination of erect penis (to exclude a potentially large number of penile and prepuce abnormalities).

Infectious disease assessment as set out by the Australian Cattle Veterinarians is summarised in **Module 6: Herd health and welfare**.

Table 1: Guidelines for minimum scrotal circumference in healthy bulls

Age	<i>Bos taurus</i> bulls and <i>Bos indicus</i> derived bulls	<i>Bos indicus</i> bulls
12–15 months	30cm	24cm
18 months	32cm	28cm
2 years and older	34cm	30cm

Serving ability

It is important to know the serving ability of each bull. The serving ability test is a useful procedure, but a meaningful result requires a trained person to use careful application of animal husbandry skills. It is recommended that a local veterinarian carry out the test under approved guidelines. The close observance of a bull during a serving ability test allows observance of sexual behaviour and libido, mounting behaviour, exteriorisation of the penis and ejaculation. Many problems are detectable on serving ability testing that may not be apparent just on a physical examination

A serving ability of 2–3 servings in 10 minutes is essential for high conception

Guidelines to serving ability:

- minimum serving ability of 2 or 3 servings in 10 minutes
- minimum time since bulls exposed to excessively hot conditions of 60 days before mating.

Preparation of bulls for mating should include:

- mating bulls of highest serving ability to heifers so that they get in calf at their first joining (cows that calve early in their first season tend to be early calvers for the rest of their lives)

Join high serving ability bulls with heifers

- selecting bulls for mating that meet the specifications set out in *Evaluating and Reporting Bull Fertility* (2003) available from the **Australian Cattle Veterinarians website**.
- ensuring access to at least one replacement bull (more in larger herds) from four weeks before mating begins
- planning mating groups eight weeks before joining and running bulls together before mating to allow social groupings to establish (mixing bulls shortly before or during mating can reduce conception rate due to distraction when fighting, and possible injury to bulls)
- vaccinating bulls with appropriate vaccine to keep the herd protected against diseases that affect fertility (described in **Module 6: Herd health and welfare**).

What to measure and when

- Ratio of bulls per 100 cows before mating each year.
- Body condition score weekly from eight weeks before mating until the end of mating.
- Physical and health check-up at eight to four weeks before and at start of mating and weekly during mating.
- Semen examination at eight and four weeks before, and at mating if infertility is suspected.
- Libido test completed at eight to four weeks before mating.
- Calving histogram prior to mating (see **Tool 5.4**).

Artificial insemination as a mating option

If artificial insemination (AI) is used, the correct procedures are required to ensure high conception and calving rates. Results from an AI program are optimised by managing:

- **cow/heifer selection** – all females in an AI program must be on a rising plane of nutrition with sufficient time post-calving to return to oestrus. As a guide for best results, maiden heifers are under less stress than mature cows, but mature cows are easier to get in calf than first-time calvers if nutrition adequate.
- **heat detection** – the accurate detection of standing heat and the resulting timing of insemination are critical to the success of an AI program. Clear identification of individual animals, record keeping, visual observation for signs of heat and where necessary, the use of

heat detection aids, are critical factors in an AI program.

- **oestrus synchronisation** – manipulation of oestrous cycles of heifers or cows to cause them to exhibit standing oestrus around the same time can greatly reduce the number of days needed to detect a group of animals in standing oestrus. Hormones common to many protocols are prostaglandin F_{2α} (PG), gonadotropin releasing hormone (GnRH) and progestins.
 - Prostaglandins – a hormone (administered by injection) that shortens the reproductive cycle by removal of the *corpus luteum* from the ovary between day 4 and day 17 of the normal oestrus cycle.
 - Progesterone implants – placed under the skin behind the ear or in the vagina (eg intravaginal CIDR or controlled internal drug release). Implants are usually left in place for 11 days to postpone the onset of oestrus until two days after removal (see **Tool 5.6** for different schedules).

Synchronisation of females will fail in animals that are anoestrus (no ovarian activity and not cycling).

Potential problems associated with CIDRs

Controlled internal drug release (CIDR) is an intravaginal device that contains progesterone and acts like an artificial *corpus luteum*. Information on the proper handling and administration of CIDRs is provided in **Tool 5.6**.

There are normally few problems associated with CIDR treatment.

CIDRs should not be inserted in cows that are less than 21 days postpartum because the probability of inducing cyclicity is low. CIDR insertion should be performed as cleanly as possible to reduce the risk of spreading disease (see **Tool 5.6**).

When removing CIDRs, it is not uncommon to detect a whitish discharge due to vaginal irritation from the wings of the CIDR, which does not necessarily mean the animal has a vaginal infection. A difference in conception rate or pregnancy rate has not been detected between CIDR-treated animals that do or do not have a discharge.

- **Care when handling semen** – semen is a live biological product that must be handled correctly and stored at the correct temperature with liquid nitrogen. It is susceptible to temperature shock and exposure to sunlight, water, blood and poor hygiene.
- **Insemination technique** – rectovaginal technique of insemination gives the best results. Insemination can be done approximately 12 hours after the onset of observed oestrus. Fixed time insemination can occur with different programs involving CIDRs and specific hormone injections, and reduces the labour and time taken up in inseminations that are timed to observed oestrus.

Proper artificial insemination technique

High pregnancy rates to fixed-time artificial insemination (FTAI) depend on a series of events, including proper storage and thawing of semen, and depositing semen in the correct location (uterine body).

When synchronising heifers or cows for FTAI, consider how many animals can be inseminated properly in a designated time. This will determine how many heifers or cows you synchronise, and whether you will require assistance with the insemination process.

Representatives of AI companies are available to assist with the entire oestrus synchronisation and AI process. They can assist you with choosing an appropriate FTAI protocol, administration of the oestrus synchronisation products, sire selection, purchase of semen, and insemination.

If you are conducting the AI process, remember that the location of semen placement within the reproductive tract will have a significant impact on pregnancy rates. It is important to deposit the semen in the body of the uterus (target area) and not the cervix. Deposition in the cervix will significantly reduce the pregnancy rate to FTAI. Placing the semen beyond the uterine body into one or both of the uterine horns is not beneficial.

During the artificial insemination process, it is important to know where the tip of the AI catheter is at all times. Some helpful tips when performing AI include:

- pay careful attention to the storage of semen
- ensure the thaw unit is at the correct temperature (37°C)
- follow the AI company's recommendations for thawing semen.

If an AI program is being considered, carefully assess the benefits and costs of the options. Calculate the costs of the various options in terms of dollars per calf born to enable a comparison of mating systems. Attend a special AI training course to gain the knowledge and skills to obtain the best results.

Pregnancy diagnosis

Guidelines to implementing pregnancy diagnosis

Aim to conduct a pregnancy diagnosis as soon as possible after either the maximum number of days from the last day of mating has been exceeded, or calves have been weaned from the cows, except in drought when calves have been weaned earlier (see **Procedure 3** for guidelines).

Schedule pregnancy diagnosis at the appropriate time for accuracy

Recommended guidelines for timing of pregnancy testing and diagnosis are:

Heifers

Ultrasound technology

- minimum 28–35 days after last day of mating
- limited use on foetus once advanced beyond 15 weeks when it drops lower over the pelvis
- very accurate on positive pregnancy diagnosis but can give false negatives
- useful in accurately ageing the foetus.

Manual palpation

- minimum 35–50 days after last day of mating
- requires experienced operators for early diagnosis at 7–10 weeks in heavy cows.

Cows with calves

- ultrasound 30 days after last day of mating
- manual palpation 50 days after last mating
- at weaning, at the very latest.

Cull all non-pregnant cows, and assess and record reasons for failure to conceive to aid future management decisions.

Use pregnancy diagnosis to cull all empty cows

It is important that pregnancy diagnosis is conducted at the correct time so that infertile heifers can be culled from the breeding herd and managed to meet market specifications for sale.

What to measure and when

- Check for presence of a foetus (or twins) on day of pregnancy diagnosis.
- Estimate age of foetus to plot calving pattern, which will assist with labour planning for calving supervision.

Procedure 3

Wean as early as possible, without compromising overall calf growth rate

In this procedure:

- Determine the weaning age of calves
- Wean calves.

Determine the weaning age of calves

Guidelines to determining the best calf weaning age

As a principle, the sooner calves are weaned the greater will be the potential turn-off of young cattle. Adopting an earlier weaning age is the single most important way to increase weaner throughput as it allows better allocation of feed to reproduction and turn-off.

Wean calves when pasture use is better for calf alone than cow-calf combination

The keys to maximising the benefits of weaning age to throughput and productivity are to:

- identify the time when the efficiency of pasture use will be greater for the calf alone than for the cow and calf together (normally around six months into lactation when the higher quality pasture required to maintain cows and produce a relatively small amount of milk is better consumed directly by the weaned calf)
- implement a weaning strategy that ensures no check occurs in calf growth.

These management practices need to be in place when weaning as early as possible, and without compromising the overall calf growth rate.

- Wean calves between 6 and 9 months of age (in line with current industry practice in southern Australia).
- Use high quality weaner pastures for rapid animal growth.
- When weaning in summer, use the best available dry pasture for the weaners.

Weaning age and projected liveweight gains post-weaning depend on pasture availability and quality. Ideally, weaning needs to take place when pasture height and availability are best for maximum intake by the weaned calf, and the pasture has a nutritional quality of more than 11.5MJ ME/kg DM and at least 15% crude protein.

In general, use the combination of age and weight of calves, and condition score of cows, as the basis for a decision to wean calves as early as possible. This is particularly important when there is a limited quantity of high quality pasture available. Determine your weaning strategy based on the following guidelines.

As a general rule, the earlier the age of weaning, the better the nutrition required for the weaners, in terms of energy and protein. In many instances, pasture alone will not be adequate and a high quality supplement will be required.

Use calf age, weight and cow condition score as indicators to earlier weaning

- Minimum 100 days from when the last calf was born and weight of the lightest calves in the group is at least 100kg. Weaning calves too early can result in calf deaths, reduced ability to thrive and reduced throughput of saleable animals.
- Maximum 6 months old depending on the season and quality of available pasture.
- When cow condition score is falling and reaches 2.5. If weaning is too late, loss in cow condition score can be so great that fertility is reduced at the subsequent joining.

Refer to **Tool 5.5** for the relationship between weaning age and liveweights for three growth rates relative to pasture quality in British breed cattle.

Early weaning

Early weaning is a useful management strategy in drought as it allows better allocation of limited feed resources.

To make an earlier weaning strategy worthwhile in normal seasons, the additional pasture (resulting from reduced consumption by lactating cows) needs to be used by increasing the number of calves reared or by other avenues (such as purchased growing stock) to achieve an increased throughput of saleable product.

Pasture saved by early weaning needs to be utilised by additional growing stock

Early weaning as a management option

Early weaning is a management strategy that can be implemented to improve throughput of sale.

Many experiments have shown that beef calves can be weaned successfully at 100 days of age and from weights as low as 100kg provided they are offered high quality feed. The feed offered to early weaned calves must be of high nutritional quality and contain more than 11.5MJ ME/kg DM and at least 15% crude protein.

Peterson et al. (1987) reported that early weaned cow–calf pairs were 43% more efficient in converting digestible nutrients into calf gain than conventionally weaned cow–calf pairs.

Early weaning of calves also provides substantial benefits to the cows through reduced weight loss during lactation, higher body condition scores and significantly shorter calving intervals.

Table 1: Energy and protein requirements of weaner steers and heifers

Liveweight steers/heifers	Daily growth rate	Max. daily intake	ME MJ/day required	Min. ME required	Crude protein %
200kg	0.0	5.5	26	4.8	8
200kg	0.5	5.5	44	8.0	12
200kg	1.0	5.5	59	10.7	13
300kg	0.0	7.6	35	4.6	8
300kg	0.5	7.6	57	7.5	10
300kg	1.0	7.6	76	10.0	13
400kg	0.0	9.4	45	4.8	8
400kg	0.5	9.4	71	7.6	9
400kg	1.0	9.4	93	9.9	13

Several experiments have also shown higher performance and better meat quality from early-weaned calves when compared with conventionally weaned animals. Earlier weaning of calves provides substantial benefits to the cows through reduced weight loss during lactation with higher body condition scores and significantly shorter calving intervals.

What to measure and when

- Age and weight of calves at 100 days from when the last calf was born (see **Tool 5.5** for projected growth paths).
- Any harmful effect on cow health and udder damage to high milk yield cows.
- Quality and quantity of pasture available for weaned calves (at least 11.5MJ/kg DM and 15% crude protein) – assess weekly immediately before the proposed weaning time, and then following weaning.

Note: The predicted effect on enterprise profitability from earlier weaning and better utilisation of available pasture by animals destined for sale can be determined in relation to variation in weaning age within **Tool 1.1** and **Tool 1.2** of Module 1: Setting directions.

Wean calves

Guidelines to yard weaning calves

Industry best practice has proven that yard weaning is a simple and effective procedure that can lift cattle productivity.

Use dedicated yards to wean calves

Cattle that are yard weaned are more familiar with stock yards, water troughs, feeding routines and people. By exploiting the fact that weaning is a critical learning time, young cattle can be well prepared for a productive future. Yard weaned groups of cattle also have the major advantage of stronger social bonds between individuals. While training cattle during yard weaning, their individual temperament (confidence) can be assessed and flighty (shy) cattle can be identified for removal or special treatment.

Weaning is an important learning phase for cattle.

The benefits of yard weaning are fully realised if cattle later go into feedlots. In the feedlot, a healthy and productive feeder steer has to:

- accept confinement and go on to concentrate feed and water quickly
- adapt easily to the initial social/psychological and metabolic stressors
- achieve high feed conversion rates and weight gain through good adaptation individually and as a feeding group
- have strong resistance to respiratory disease, partly as a result of social compliance and group cohesion

- accept the presence of people, vehicles and horses at close quarters.

Guide to yard weaning

The following requirements must be met to implement yard weaning as a management tool.

- Well built, weaner-proof yards with solid opaque pen sides (rubber belting 1.2m wide is ideal).
- A reasonably sloped, well drained, non-bog surface.
- Pen stocking density of 4m²/head for 180–260kg calves, and 2.5m²/head for 100–170kg early-weaned calves.
- Weaners kept in the yards for 5–10 days (with the aim to have the majority back onto high quality pastures as quickly as possible).
- Cattle fed daily with high quality hay or silage (at least 11.5MJ ME /kg DM and 15% crude protein) – the feed does not need to be supplied in a bunk or trough and can be successfully fed through a round bale feeder.
- Good quality drinking water supplied in a trough.
- Shy feeders removed and managed as a separate group to prevent rapid and excessive weight loss.
- Routine human contact each day (eg walking quietly through the yard at least two or three times each day).
- In general, keep dogs away from the weaning yard.

Handling at weaning

Positive contact between humans and weaners minimises management problems down the track

Weaned calves should be encouraged to approach humans with a memory of positive associations. Grouping calves in a small area at weaning with regular handling boosts socialisation between animals and with humans, and reduces subsequent stress associated with handling and transport. Well-behaved stock will generally create fewer management and work safety problems.

Negative or insufficient positive contact between humans and calves at weaning can result in the animals remaining frightened of human activity. This can cause increased stress during handling and transport, high pH and dark-cutting meat. Insufficient contact with humans can also lead to cattle not adapting well to more intensive feeding, such as in drought feeding or feedlots.

Weaner pastures

High quality feed produces rapid liveweight gains in weaner cattle

Depending on the month and seasonal conditions at weaning, the liveweight of weaner cattle may be maintained until feed conditions improve or they can be weaned onto high quality pasture for rapid growth rate. As a guide for best liveweight gain, weaner pastures should be of a nutritional quality of at least 11.5MJ ME/kg DM and 15% crude protein. If high quality pastures are not available at weaning and weight gain is desired, consider providing a feed supplement to boost the nutritional quality of the diet, but ensure that the cost of a supplementary feeding option does not exceed the benefits.

Careful management of weaning pays individual and industry dividends

Weaning needs to be carefully managed to avoid any check in post-weaning growth and productive performance of calves. Pay special attention to pasture quality (at least 11.5MJ ME) and calf management to ensure successful transition to a pasture or pasture plus supplement-based diet.

What to measure and when

- Measure the nutritional (energy and protein) content of post-weaning feed for 3 months after weaning.
- Monitor pastures at least weekly, and more often if seasonal conditions are deteriorating. See **Module 3: Pasture utilisation** for information on the assessment of pasture quantity and quality.

Further information

- *MLA Tips & Tools* 'Yard weaning methods for preparing feeder cattle' available online: <http://www.mla.com.au/publications>
- Yard wean to boost production, *MLA Prograzier*, Spring 2003, p19.

Procedure 4

Implement a female culling and replacement policy to maintain best herd structure

This procedure covers:

- culling heifers and cows
- retention rate of heifers.

Guidelines for culling heifers and cows

Cull as early as possible but at a convenient time, commonly at weaning of calves. Initial culling is for females empty at pregnancy diagnosis or that experienced calving difficulties at the previous calving. Ultrasound pregnancy testing allows earlier diagnosis of pregnancy to be achieved accurately and earlier tactical culling decisions.

If pregnant, then cull on physical factors such as unsound feet and legs, damaged or lost teeth, aged over 10 years (or required age structure of the breeding herd for desired rate of genetic progress), history of calving difficulty or inability to wean a calf.

To achieve the targeted rate of genetic progress and change in herd structure, a defined culling policy is needed for older cows.

Carefully consider how to achieve a balance between the number of older cows in their optimum productive years, say between their third to sixth gestation, and the influx of new generation heifers as replacements.

If the animal is required during a change in the age structure or rebuilding of the herd, re-mate and manage as a group separate from the main herd. The cost of culling all infertile cows (ie not pregnant after 45 days mating) in a program aimed at realigning calving pattern can be too high to complete in one year. Correcting an unsatisfactory spread in calving may need to be completed over three years (refer to 'Guidelines for reducing the spread of calving' in Procedure 2).

When infertile heifers and cows without calves are not culled, these non-pregnant animals consume pasture that can be productively used to grow stock and increase the throughput of saleable product. If retained, these culls should be grown to a saleable weight for a target market.

What to measure and when

- Presence of foetuses at pregnancy diagnosis.
- Fat deposition rates to avoid fatty udder syndrome.
- If pregnant, then physical factors such as structural soundness, teeth, age, ability to wean a calf and history of calving difficulty.

Guidelines for the retention rate of heifers

Select replacement heifers

Heifers intended as replacement breeders must be selected for their ability to:

- reach critical mating weight (CMW) on a desired joining date
- become pregnant
- deliver a live calf unassisted
- rear a calf to satisfactory weaning weight
- re-conceive within 82 days of calving to maintain a 365-day calving interval.

When determining the number of heifers to join, it is important to allow for culling of heifers that fail this screening test. If too few heifers are retained, the balance of the breeding herd (target size and desirable age structure) cannot be maintained from year to year. Another option may be to purchase pregnancy-tested cows in-calf, but the impact on the herd age structure and breeding objective would need to be carefully assessed along with the issue of biosecurity.

Calculate the number of replacement heifers required

When too many replacement heifers are retained, they consume more high quality pasture per calf born than older cows. Although heifers lower the average age of the herd, they are more labour-intensive at calving and wean lighter calves. However, excess heifers can become valuable sale animals and increase the ability of a beef business to access a range of target markets.

Assess the numbers of heifers retained for breeding in terms of age structure of the herd and long-term sustainability

Assess the effect on profitability of options for maintaining heifers to increase enterprise flexibility, such as selling grown heifers (see Module 1: Setting directions).

Determine culling rate

Culling rate is determined basically by the heifer retention rate. High culling rates are possible only when the heifer retention rate exceeds 60–80%, which is only achieved with a high degree of reproductive efficiency. This can only happen when:

- short joining periods are achieved
- high numbers of heifer calves have enough growing days to achieve the critical mating weight
- adequate nutrition is available from weaning to joining
- adequate nutrition is available from joining to calving to minimise dystocia and facilitate return to oestrus in first-calf heifers and mature cows.

High culling rates are beneficial in that they:

- shorten generational interval and optimise genetics
- allow for high selection pressure on poor producers
- reduce the average age of the herd and minimise natural attrition
- effectively value add the retained heifers whose sale value at weaning is often lower than the cost of production, and allow higher numbers of old cows to be sold
- increase herd flexibility to change direction and exploit market opportunities.

Table 1 shows the effect of higher retention rate of heifers and the ability to exert more selection pressure on the herd through a higher culling rate of cows over and above culling the empty cows.

Table 1: Heifer retention and cow culling in a 500-cow herd

Heifer retention rate	Number of heifers retained	Number of cows culled to keep 500 cows
40%	88	41
60%	132	84
80%	176	128
Pregnancy rate		93%
Cow mortality rate		2%
Calf survival rate		95%

Nearly all the negative aspects of poor reproductive efficiency, apart from disease processes, can be attributed to failing to meet the nutritional requirements of breeding herds at particular times in their breeding cycle. Failure in this area is the greatest single cause of economic failure; not failed seasons, poor prices or other things out of our control.

Culling consists of removing unwanted cows from the breeding herd based on:

- poor performance (the same poor performing cow repeats it next year)
- low fertility and late calvers
- aged cows
- other reasons (eg cancer in the eyes, teats, hips and feet).

An example using mathematical modelling

Start with 500 heifers, and assume:

- 88% pregnancy rate to three oestrus cycles
- 2% annual cow mortality
- 3% of cows who calve fail to wean a calf
- no herd replacements.

Table 2: Natural rate of attrition in a 500-cow herd without any culling

Year 0	1	2	3	4	5	6	7	8
500 heifers	415	344	286	237	197	163	135	112

Table 2 shows the natural rate of attrition before any culling for production takes place. After 8 years, only 112 of the initial 500 cows remain in

the breeding herd. This means that, assuming a fertility rate of 88% and a heifer retention rate of 40%, only 12 surplus old cows can be culled to retain a 500-cow herd.

What to measure and when

- Determine the number of heifers to be retained in the breeding herd immediately after pregnancy diagnosis of the heifers.



Minimum liveweights of weaner heifers

This tool provides a guide to minimum liveweights of weaner heifers at puberty, at mating when 15 months of age, during pregnancy and at calving.

Frame score	LW at puberty	Mating LW at 15 months	LW at 0–3 months pregnancy	LW at 4–6 months pregnancy	Calving LW at 24 months	Mature LW at 60 months
1 Jersey	240	260	296	319	333	400
2 British	270	300	342	369	387	470
3 Limousin, Devon	290	330	377	409	430	530
4 Simmental	310	365	419	454	478	600
5 Charolais	340	400	459	499	525	670

LW = liveweight

Subtract up to 10kg for crossbred females.

Source: adapted from Laster et al., 1972 *J Anim Sci* 34(6): 1031–1036 and Patterson et al., 1992 *J Anim Sci* 70(12): 4018–4035.

Condition scoring beef cattle

John Graham, Hamilton

Source: Department of Primary Industries, Victoria Agriculture Note AG0113 – May 2003. Available online at www.dpi.vic.gov.au

The body fat reserves of beef cattle are important at critical stages of the production cycle. At the beginning of winter they influence the amount of feed required to ensure satisfactory reproductive performance. The objective of condition scoring is to obtain a simple and reliable estimate of the body fat reserves of live cattle. The condition score provides an estimate of fat reserves that is independent of size and is a more reliable descriptor than liveweight alone.

Condition scoring can aid cattle management in two ways.

- Breeding cows: assessment of body condition at critical stages of the production cycle identifies those cows in need of nutritional management to reach target condition scores.
- Fattening animals: knowing the condition of fattening cattle allows selection of those with the desired level of fat cover for target markets (see Module 7: Meeting market specifications).

Target condition scores for cows:

- No lower than 2.5 at calving for autumn calving
- No lower than 2.5 at the start of mating for autumn calving
- No lower than 2.0 at calving for spring calving cows

Cows can be drafted at weaning on condition score so that preferential feeding can be given to those that may not achieve their target scores by calving.

Condition scoring techniques

The technique is easily learned and, although subjective, has been shown to give reliable results when related to subcutaneous fat cover. The method is a 'hands-on' system, where two areas of the animal's body are palpated to assess fat cover (see Figure 1). The two areas are:

- spinous processes or short ribs
- around the tail head.

The short ribs

The degree of prominence of the short ribs of the individual spinous processes, is found by placing the fingers flat over the short ribs and pressing the thumb into the end of the short ribs (see Figure 2). A condition score is given according to the ease with which the individual short ribs can be felt with the thumb.

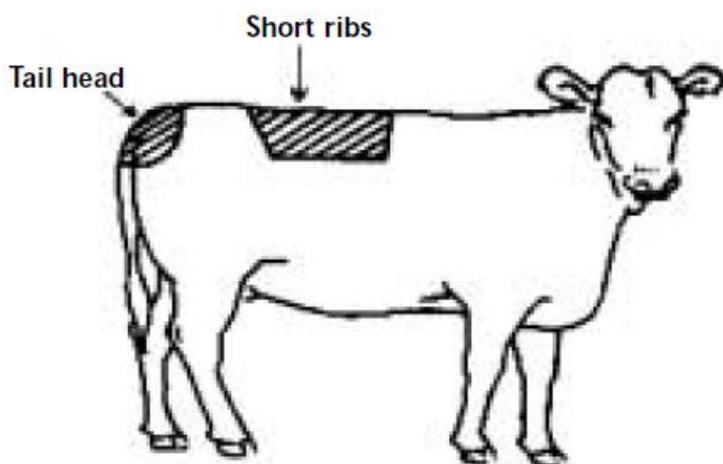


Figure 1: The tail head and short ribs areas are palpated to assess fat cover

The tail head

The degree of fat cover around the tail head is assessed by using the fingers and thumb and should be done at the same time as assessing the short ribs. The appropriate score is given depending on the degree to which palpable fat can be felt.

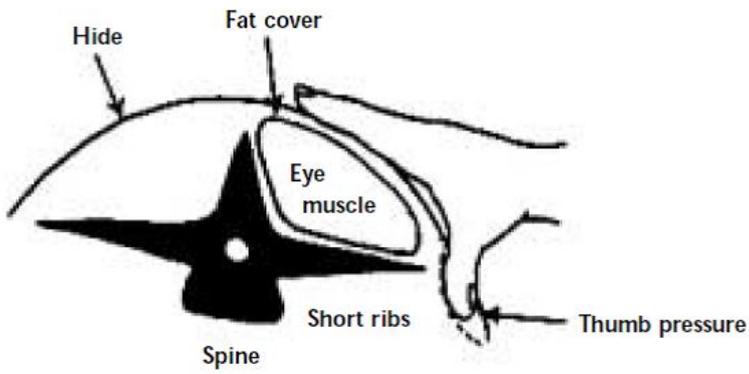


Figure 2: The degree of fat cover around the tail head and short ribs is assessed using the fingers and thumb

The scores are described as follows:

1. Emaciated.
2. The individual processes are sharp to the touch, no tail head fat. The hip, bones and ribs are prominent.
3. The individual processes can easily be felt, but feel rounded rather than sharp. There is some tissue cover around the tail head. Individual ribs are no longer visually obvious.
4. The short ribs can only be felt with firm thumb pressure. Areas either side of the tail head have fat cover which can be easily felt.
5. The processes cannot be felt and fat cover around the tail head is easily seen as slight mounds, soft to touch. Folds of fat are beginning to develop over ribs and thighs.
6. The bone structure of the animal is no longer noticeable and the tail head is almost completely buried in fatty tissue.

The score can be varied half a score depending upon the amount of tail head fat, for example if the short rib palpation (using the thumb) gives score 4 but the tail head is a typical 3, the score would then be 3.5. Scores can be directly related to fatness at the P8 site.

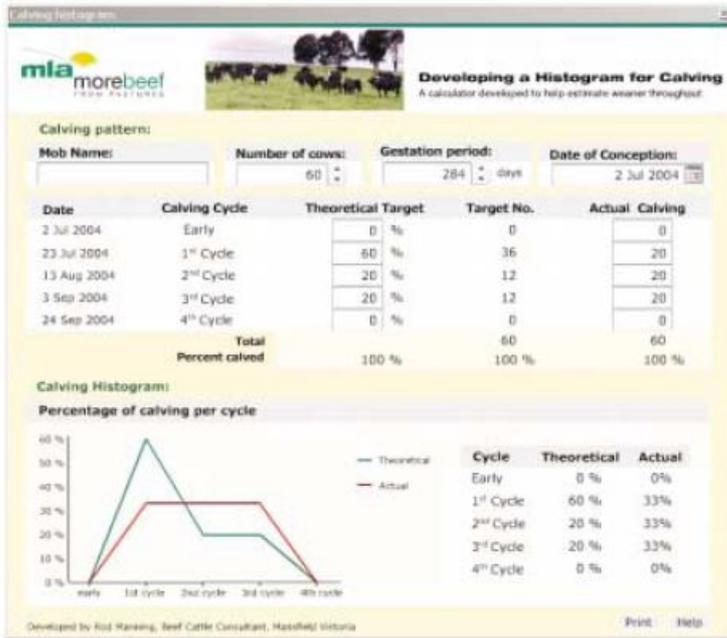


Evaluating and Reporting Bull Fertility

Copies of this publication and the associated 'Bull Reporter' can be obtained through the Australian Cattle Veterinarians office (07 3423 1799). Information is provided online at <http://acv.com.au>

Calving Histogram Calculator

A spreadsheet calculator develops a calving histogram to identify the percentage of cows conceiving at each cycle.



Weaning age and projected liveweights

The following table shows weaning and projected live weights for three target growth rates relative to pasture quality in British breed cattle.

Projected growth rate to weaning (kg/day)	Pasture quality (MJ ME/kg DM)	Assumed birth weight (kg)	LW at 100 days of age (kg)	LW at 150 days of age (kg)	LW at 200 days of age (kg)	LW at 250 days of age (kg)
1.1	12.0 (80% digestibility)	36	146*	201	256	311
0.9	10.5 (70% digestibility)	34	124	169	214	259
0.7	9.0 (60% digestibility)	31	101	136	171	206

LW = liveweight

* Calculated as $(1.1 \times 100) + 36 = 146\text{kg}$

Source: data extrapolating from results of the high, medium and low pre-weaning pasture treatments used in the crossbreeding research project conducted by NSW Agriculture at Grafton, NSW.

Note: These are averaged projections over the whole pre-weaning period. There will be a range in weaning weights either side of these values, and the range will be greater in herds with extended mating seasons. As such, earlier weaning at an age of 100–120 days (and a minimum liveweight of 100kg) can be successful for calves grazed on the high quality pastures (greater than 11.5MJ/kg DM). Earlier weaning should be managed carefully, particularly if calves are grazed on lower quality pasture to weaning. Ensure that they are heavy enough, and that there is an adequate supply of high quality feed for these calves during and after weaning.

Artificial Insemination (AI)

Proper handling and administration of progestins for estrus synchronisation (controlled internal drug release)

1. Be sure to wear protective (eg latex) gloves when handling inserts for controlled internal drug release (CIDR).
2. The CIDR applicator should be rinsed in a disinfectant solution (Nolvasan or Chlorohexidine). There should be two buckets of disinfectant solution. The applicator should be washed free of debris in the first bucket and then rinsed clean in the second. By keeping the same washing sequence the disinfectant in the second bucket will remain relatively clean for a sustained period of time. This sequence of events will improve sanitation from animal to animal and reduce the likelihood of infection.
3. Fold the wings of the CIDR and insert it into a clean applicator. The CIDR will protrude approximately 2.5cm from the applicator.
4. Apply lubricator to the end of the applicator.
5. Wipe the vulva clean before inserting the applicator.
6. When inserting the CIDR make sure that the nylon tail is curved downward. If the tail is pointed upward it will be easier for other animals to pull out the CIDR thus reducing retention rate.
7. Gently insert the applicator containing the CIDR in an upward manner similar to the insertion of an AI catheter.
8. Push the applicator as far forward as possible, deposit the CIDR by pressing the plunger, and slowly remove the applicator.
9. To prevent other animals from removing the CIDR, the nylon tail can be clipped such that only 6cm protrudes from the vulva.
10. At CIDR removal, gently but firmly pull on the nylon tail until it is removed. Be sure to dispose of the CIDR properly.

AI program checklist

Things to do before fixed-time artificial insemination (AI)

- Keep accurate calving, breeding and pregnancy records.
- Animal identification should be clear and easily readable.
- Ensure herd health and disease prevention with a well designed pre-breeding vaccination protocol. Vaccinate females a minimum of 30 days before the breeding season begins.
- Decide which estrus synchronisation protocol best fits your breeding program, facilities, and personnel (see protocol sheets in AI catalogs).
- Ensure all products are purchased and on-hand prior to initiation of the protocol.
- Prepare the calendar of actions to ensure protocol compliance.

Sire selection

- Determine if you will purchase or raise replacement heifers.
- Decide how you will market your calves.
- Select proven AI sires with high-accuracy EBVs that match performance goals.
- Purchase semen from a Certified Semen Services (CSS) collection facility.
- Prepare or update your semen inventory.
- Make sure females meet the criteria for being good candidates for estrus synchronisation.

Heifer criteria

- Heifers should weigh 65% of their mature body weight by the start of breeding.

Cow criteria

- Synchronise and inseminate only cows with BCS at calving of ≥ 3 (1 = emaciated; 5 = obese).
- The average days postpartum of the group of cows to be synchronised should be ≥ 40 days by the start of estrus synchronisation and experience a minimum of dystocia.

Things to do at the time of estrus synchronisation and AI

- Meticulously follow the estrus synchronisation protocol!
- If detecting estrus, spend as much time observing the animals as possible.
- Use a minimum of one person to detect estrus per 100 head of cattle.
- Use estrous detection aids to facilitate visual observation of estrus.
- Use a properly trained technician for AI.

Things to do after fixed-time AI

- To distinguish between AI and bull bred pregnancies at pregnancy diagnosis, wait approximately 10 days to turn in clean up bulls after AI.
- Pregnancy check by 75 days after AI via ultrasound or 80–90 days after AI via rectal palpation to distinguish AI from bull bred pregnancies.
- If cattle need to be shipped do so between days 1–4 after AI and avoid shipping cattle between days 5–42 after AI.
- Maintain breeding females on an adequate nutrition and mineral program.

PAY ATTENTION TO DETAILS

Fixed time AI protocols for heifers

Source: Applied Reproductive Strategies in Beef Cattle (ARSBC) Proceedings

Figure 1: Treatment schedules for heifers in the multi-state controlled internal drug release (CIDR) trial (Lamb et al., 2006).

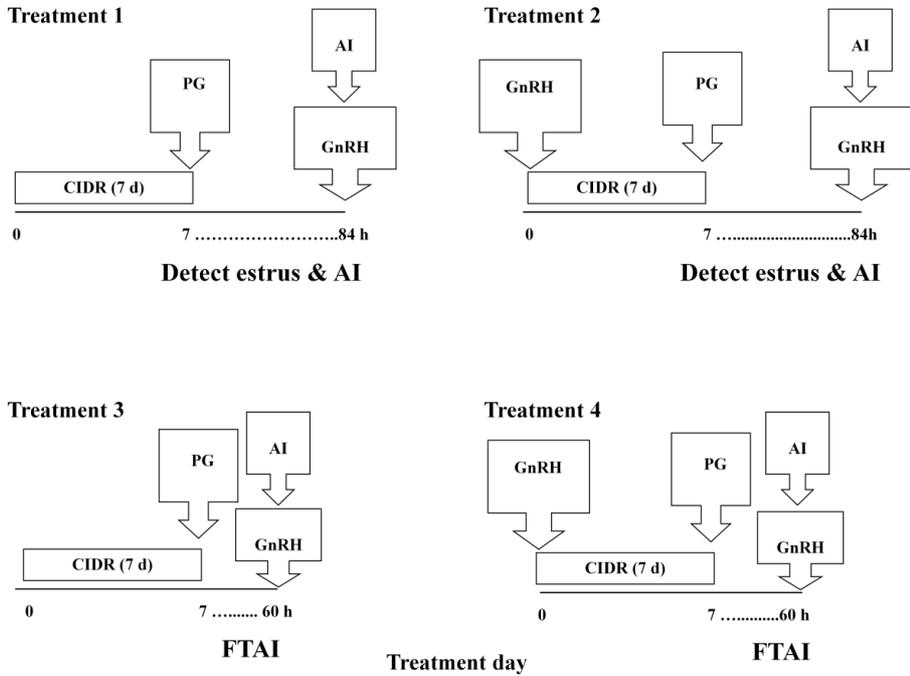


Figure 2: Oestrus synchronisation schedules involving use of the CIDR Select protocol in breeding programs for beef heifers that require heat detection or fixed-time AI.

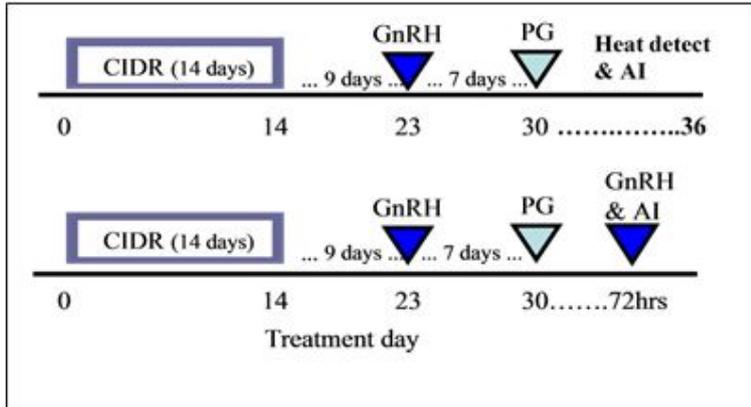


Table 1: Oestrus detection – time of day when cows exhibit standing estrus

Time of day	Cows exhibiting standing oestrus
6am to 12pm	26.0%
12pm to 6pm	18.1%
6pm to 12am	26.9%
12am to 6am	29.0%

Source: Adapted from Hurnik and King (1987); Xu et al. (1998), Perry, GA (unpublished data).

Table 2: Time course of early bovine embryo development

Event	Day
Oestrus	0
Ovulation	1
Fertilisation	1
First cell division	2
8-cell stage	3
Migration to uterus	5–6
Blastocyst	7–8
Hatching	9–11
Maternal recognition of pregnancy	15–17
Attachment to uterus	19
Adhesion to uterus	21–22
Placentation	25
Definitive attachment of embryo to uterus	42
Birth	285

Source: Adapted from Shea, 1981, Flechon and Renard, 1978, Peters, 1996, Telford et al., 1990.