DairyNZ body condition scoring

The reference guide for New Zealand dairy farmers

Sustainable Farming Fund
www.maf.govt.nz/sff

DairyNZ

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Version 2 - 10/2021

DNZ10-102

Contents

Preface

This resource is a companion to the DairyNZ Body Condition Scoring Made Easy field guide. It aims to provide farmers and rural professionals with advice on body condition score (BCS) targets, the effect of management strategies on BCS, and an overview of how to use the DairyNZ BCS method to get accurate and consistent results whenever cows are scored.

This reference guide summarises a scientific review on the effect of BCS on key productivity-related traits and animal welfare, and the relationship between farm management, cow genetics and nutrition on BCS change. The review was compiled by an international team led by DairyNZ scientists. It has been published in Journal of Dairy Science (J. Dairy Sci. 92:5769–5801) and can be accessed, in full, at **www.journalofdairyscience.org.**

The scientific review and this resource have been made possible through the support of DairyNZ and the New Zealand Ministry for Primary Industries, Sustainable Farming Fund.

Introduction

A cow's body condition score (BCS) is a reasonably accurate estimate of her energy reserves, and BCS targets at key stages of lactation have been identified to optimise dairy production systems. These targets are based on research studies undertaken in New Zealand and internationally over the last 40 years. These studies were summarised in a scientific review published in *Journal of Dairy Science* led by DairyNZ scientists. The contents of this review confirmed and quantified the recognised effects of BCS on dry matter intake, milk production, reproduction, and cow health and welfare. In addition, there was evidence that BCS in early lactation can affect the sex of future calves and the productive and reproductive capacity of heifers yet to be born.

Irrespective of the system of farming (low or high input), cow genetics, or the country where the research was undertaken, productivity was optimised when mature cows calved between BCS 5.0 and 6.0 and when first and second calvers were 0.5 BCS units fatter than mature cows. That said, the productivity benefit declined with increasing BCS and the risk of metabolic health disorders at calving was greater, such that increasing BCS beyond 5.0 in mature cows and 5.5 in first and second calvers cannot be justified economically or from an animal welfare perspective. The recommended calving BCS targets provide a compromise between optimising energy reserves for milk production, while minimising cow health issues caused by over-fatness. To ensure calving BCS targets are achieved, the most appropriate management strategies are explored in this resource.

Although target BCS recommendations tend to be herd-focussed, the review also highlighted the need to consider individual cow BCS. Animal welfare is concerned with the state of the individual cow, not the average of the whole herd. Achieving the desired herd average target may still leave a significant proportion of cows that are too thin, or too fat. The *Dairy Cattle Code of Welfare 2019* (New Zealand Ministry for Primary Industries) outlines the minimum standard for body condition score for dairy cows.

Contrary to popular belief, farm management and nutrition in very early lactation (first four to five weeks after calving) has little impact on the speed at which a cow loses BCS or the amount of BCS lost. However, mid and late lactation management and nutrition, and nutrition when the cow is dry, influence how fast a cow gains (or loses) BCS. Management strategies that facilitate achieving BCS targets are presented in this resource.

This resource should be used as a companion to the DairyNZ **Body Condition Scoring Made Easy** field guide. It provides the justification for the targets and management strategies to help achieve the targets.


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Section 1
Assessing BCS

Assessing BCS using the DairyNZ method

Key points

- Body condition score (BCS) is a subjective assessment of a cow's energy reserves, rating the "fatness" of a cow on a scale of 1 to 10, where 1 is emaciated and 10 is obese.
- Using the DairyNZ BCS method helps standardise how cows are scored. The DairyNZ BCS method was developed over 40 years ago and is internationally recognised.
- When learning to body condition score it is important to calibrate the eye by scoring cows using the "hands-on" method (see **page 12**).
- To ensure independent, accurate and consistent body condition scoring, use a Certified BCS Assessor.
- For much of the year an average BCS (and range) of the herd will be appropriate. At least 70 randomly selected cows should be scored in each herd. However, there are key times during the year where scoring all cows is important.
- The most important time to body condition score individual cows is during summer and autumn. Scoring all cows at this time will allow individuals to be managed differently (see **pages 28-31**) to ensure BCS targets at calving are met.
- The DairyNZ tracker app makes recording scores easy: **dairynz.co.nz/bcs-app**

Important body points to consider when condition scoring cows.

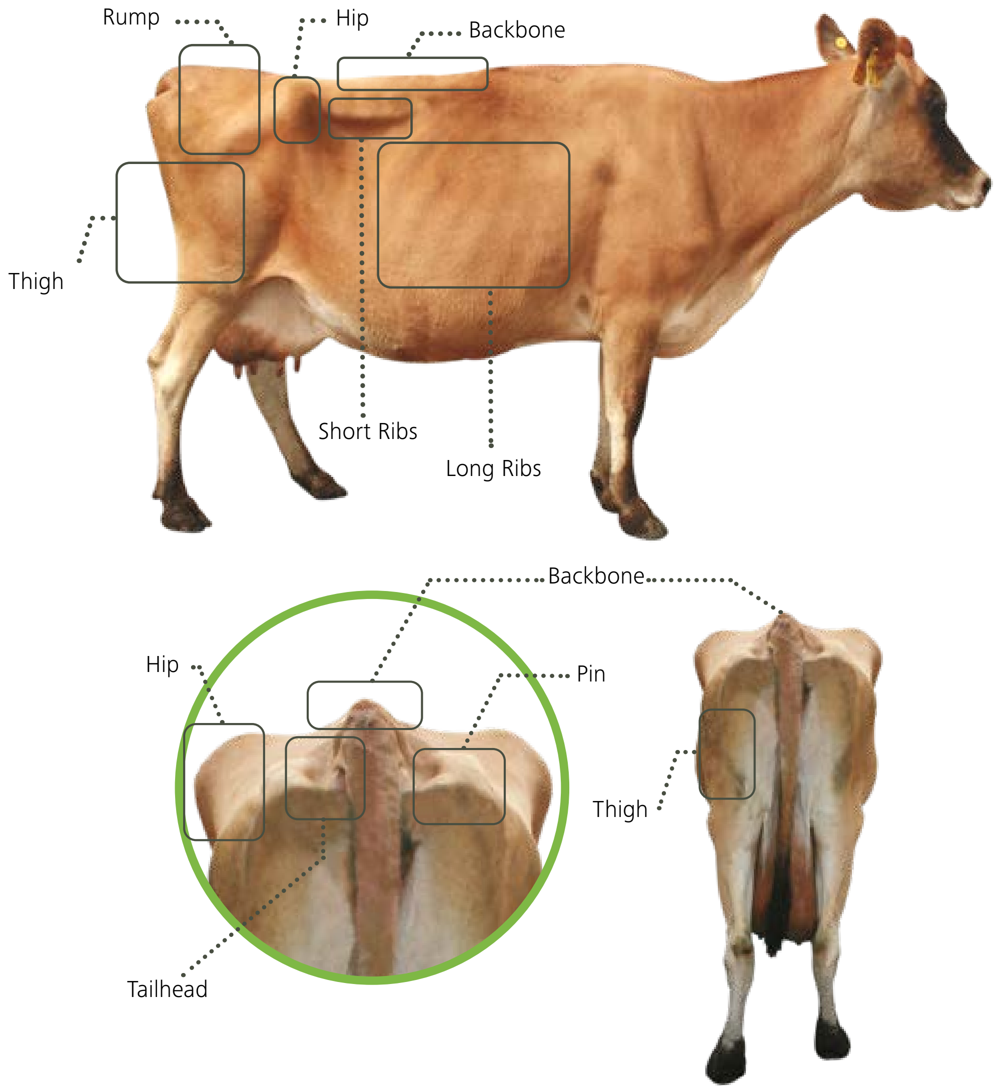


Table 1. Quick guide to body condition scoring

Body part	Descriptor
Backbone	Is it flat or is there a ridge? Can you see or easily feel notches?
Long ribs	Can you see or easily feel the ribs? If visible, how many can you see?
Short ribs	Can you see the short ribs? What do they feel like? Are the rib ends sharp or rounded?
Hip bones	Are the hip bones rounded or angular?
Rump	Is the area between the pins and hip bones, flat, sunken or hollow?
Pin bones	Are they pointed, tap-like or rounded?
Tailhead	Is there a hollow between the tail head and pin bones? Is it a deep V or shallow U shape?
Thigh	Is the area indented, flat or rounded? Is the muscle structure defined?

Why use the DairyNZ BCS method?

There are several different methods for assessing BCS with varying degrees of accuracy or consistency. The method developed and supported by DairyNZ is regarded as the standard.

1. Introduced and developed over 40 years ago, the method is internationally recognised. It forms the basis of milk production, reproduction and animal health publications quantifying the effect of BCS on productivity and sustainability for New Zealand dairy systems.

2. The standard is recognised and recommended by the Ministry for Primary Industries and embedded as Schedule II in the *Dairy Cattle Code of Welfare* 2019.

3. Dairy cattle in New Zealand vary considerably in size and frame compared with dairy cows in other parts of the world. There is also variation in the way New Zealand dairy cows store fat reserves across their bodies. The method outlined in the DairyNZ *Body Condition Scoring Made Easy* field guide takes this variation into account by assessing fat reserves at multiple points across the frame of the animal to correctly assess overall BCS.

4. Once mastered, the method is fast and accurate.

5. The method is supported by additional BCS resources, such as those available at **dairynz.co.nz/bcs**

BCS versus live-weight

Liveweight (Lwt) change is not a good indicator of BCS change. This is why BCS systems were developed globally. Factors such as breed differences, cow to cow variation in size within a breed, change in gut fill, pregnancy and heifer and second calver growth prevent the use of Lwt as an accurate measure of an individual cow's energy reserves. New Zealand research results indicate that Lwt change only explains 25% of the variation in BCS change.

Despite its limitations, many farmers measure Lwt as an indication of how much BCS a cow has gained or lost. As a guide, the average amount of weight gain/loss for every unit of BCS change is equivalent to 6.58% of a cow's total Lwt.

Average Lwt change per BCS unit for common breeds are as follows:

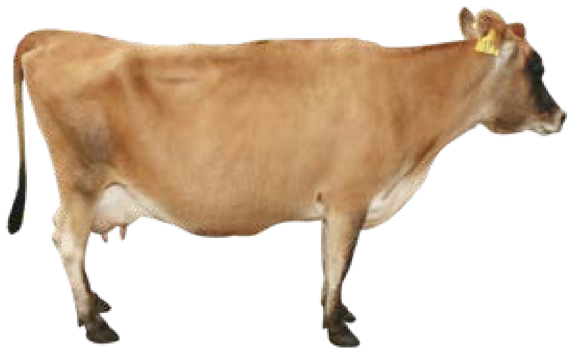
• Jersey (425 kg Lwt)	1 unit change in BCS = 28 kg
• Crossbred (475 kg Lwt)	1 unit change in BCS = 31 kg
• NZ Holstein-Friesian (500 kg Lwt)	1 unit change in BCS = 33 kg
• Overseas Holstein-Friesian (550 kg Lwt)	1 unit change in BCS = 36 kg

Even with training and experience, an assessor can only score cows to a 0.5 BCS unit visually with confidence. Remember, 0.5 BCS units is only 14-16 kg Lwt.

Breed variation and BCS

Although there are significant differences in size and angularity between the common New Zealand dairy breeds, the same guidelines for BCS assessment can be applied to all breeds.

Jerseys are typically smaller framed, with a comparatively narrow body and prominent hip bones.



Crossbreds and New Zealand-type Holstein-Friesians are medium framed animals that carry fat reserves evenly over the body.

New Zealand-type Holstein-Friesians are generally, shorter, rounder and blockier than the larger overseas Holstein-Friesian type.

Overseas Holstein-Friesian are more angular, appear thinner and tend to carry more body fat over the long ribs and less around the tailhead than New Zealand-type Holstein-Friesians.

How to BCS

Body condition scoring is a simple process. However, it is important to calibrate the eye by first condition scoring cows "hands on":

Line up 15 cows with a range of BCS in a vet/AB race

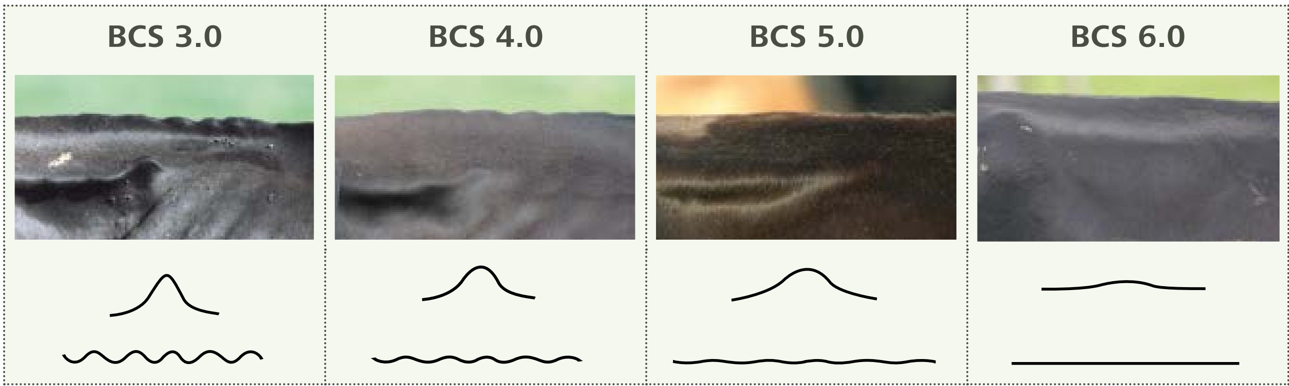
- Put your hands on the eight body parts of the cow outlined below.
- Feel the amount of fat cover over the various body points and the difference between the cows. Note that gut fill can give a visual impression of condition over the ribs, therefore it is important to feel the amount of fat cover.
- The overall BCS of the cow will be the average of the scores for the eight body parts.

Backbone

When assessing the backbone, look at the ridge formed by the spine above the short ribs (loin).

From the rear of the animal, is the backbone ridged and prominent or rounded and flat?

From the side of the animal, are notches formed by the individual vertebrae visible or is the ridge of the back smooth?

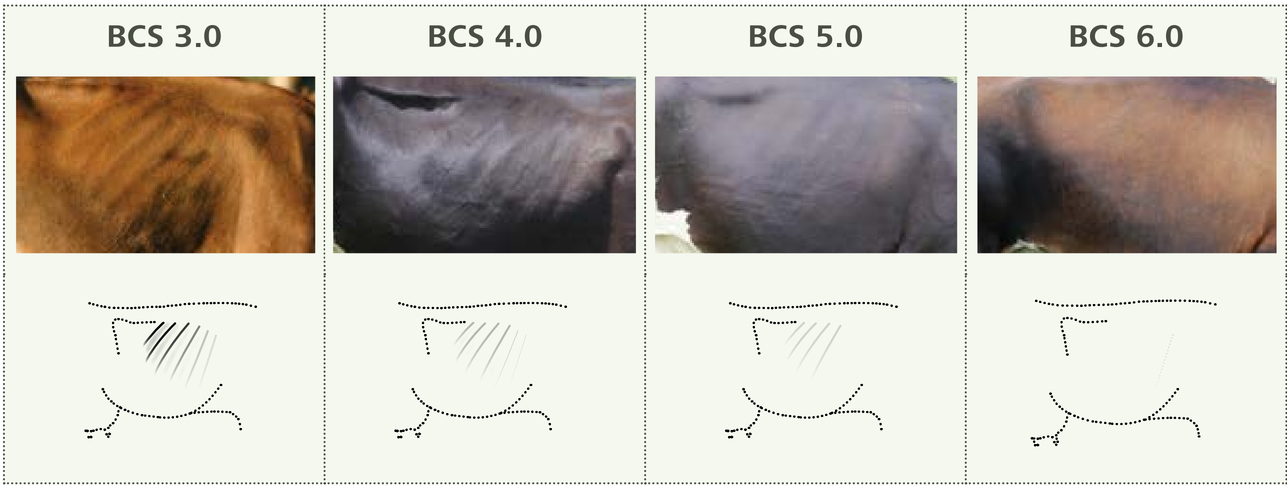


If no notches are visible, then BCS for the backbone is greater than 4.0. If notches are visible, then BCS is 4.0 or less.

Long ribs

As BCS falls, long ribs gradually become more apparent. The last rib closest to the tail is the first to be seen and then more ribs appear toward the head as BCS falls (this area in particular can be influenced by shadow, cow colour and whether the cow is wet or dry).

Can the ribs be easily seen and, if so, how many? If the long ribs cannot be seen from a distance can they be felt?



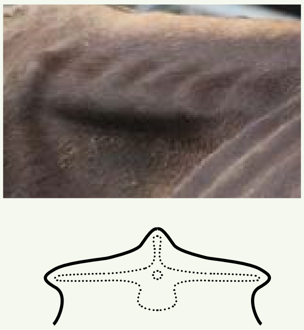
If long ribs are not visible, the BCS for this part is more than 5.0.
If long ribs are visible down to the level of the udder, then the BCS for this part is below 3.0.
Note, if the overall BCS for the cow is below BCS 3.0, then urgent remedial action must be taken.

Short ribs

The "short ribs" of a cow are not actually ribs at all; they are part of the spine called transverse processes. As BCS falls, the ends of these bones become more pronounced and sharper to the touch. Short rib scores can be influenced by rumen fill. When the rumen is full, the "triangle" below the short ribs is filled on the animal's left-hand side, giving the impression that the animal is carrying more condition than it actually is.

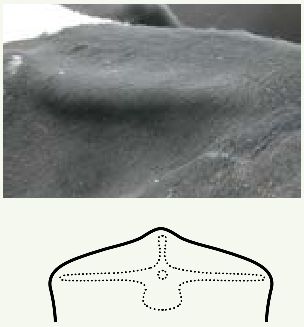
Can the short ribs be easily felt? Are the ends of the ribs sharp, smooth or rounded?

BCS 3.0

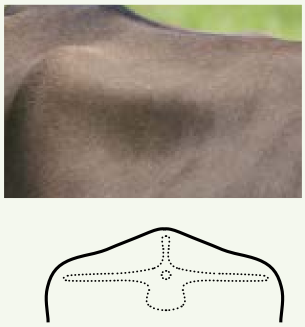


BCS 4.0

BCS 5.0



BCS 6.0



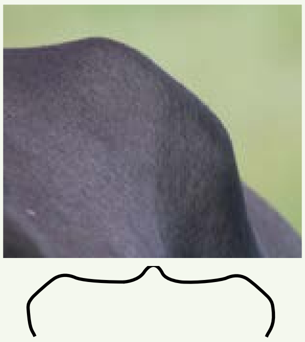
When scoring cattle, it is important to view the right-hand side of the animal so as not to be influenced by rumen fill. If the short ribs have a "gloved fingers" appearance, BCS for this part is less than 4.0.

Hip bones

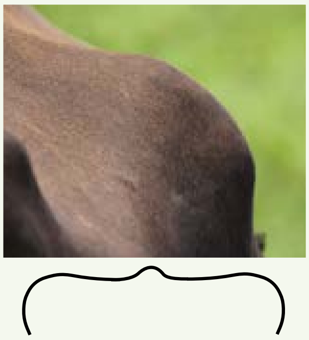
Sometimes referred to as "hooks" or "hook bones". Are the hip bones angular and sharp or are they smooth and rounded?

BCS 3.0

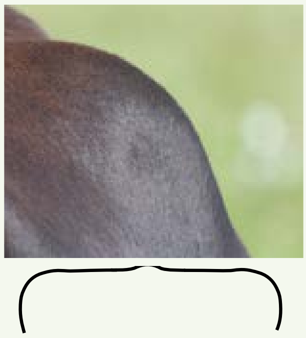
BCS 4.0



BCS 5.0



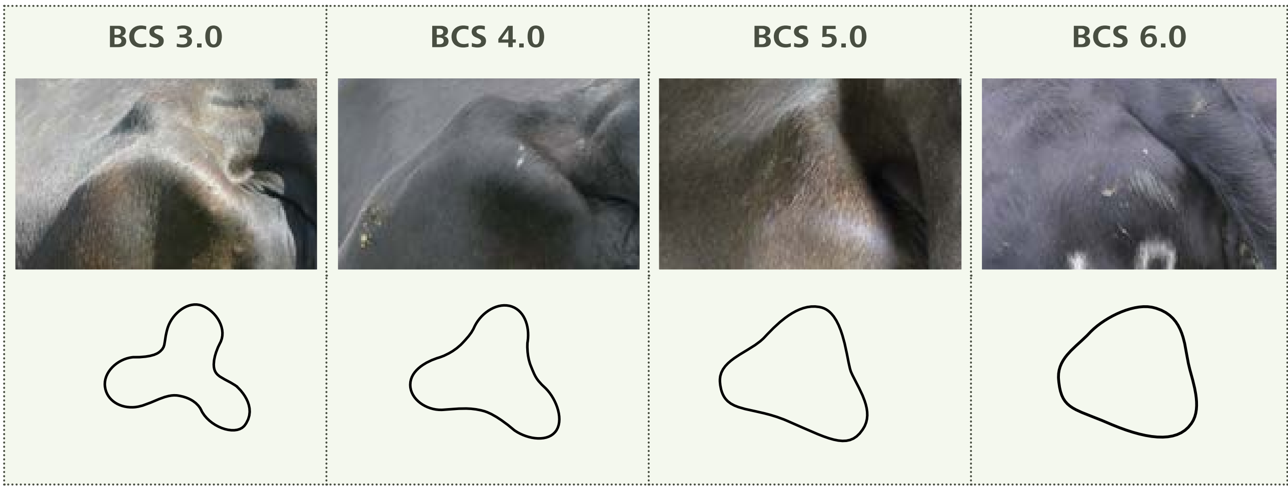
BCS 6.0



Place a cupped hand over the hip bone. If the hip bone feels rounded, BCS for the hip bones will be 5.0 or more.
If there are depressions either side of the hip bones, BCS will be 3.5 or less.

Pin bones

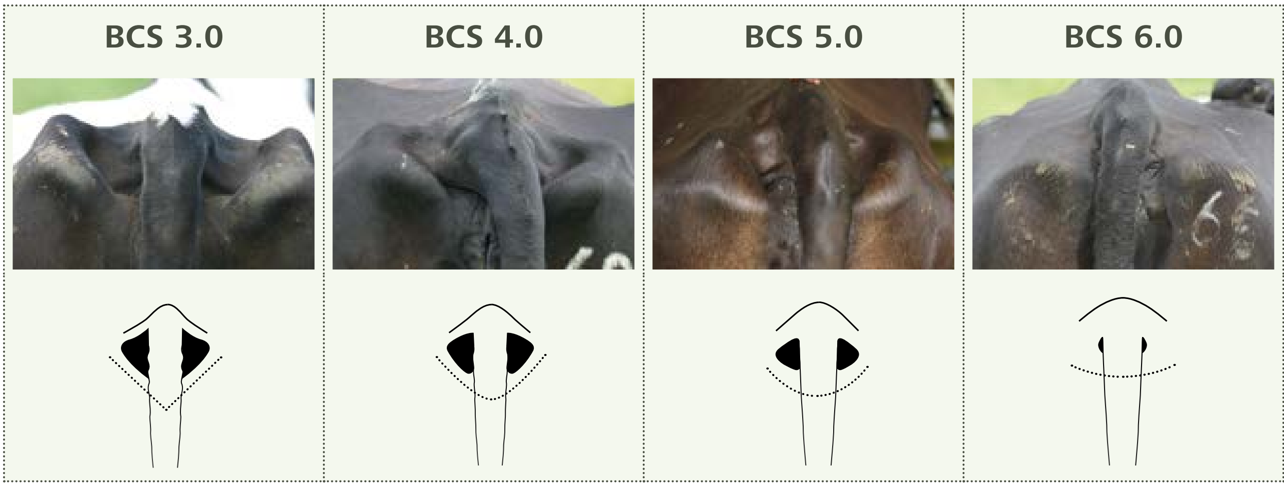
The pin bones protrude either side of the tailhead and become rounded with fat deposits as BCS increases. Are there dimples/indents between the points of the pin bones? Are the pin bones angular or rounded?



If the pin bone forms a tap-like shape, BCS for the pin bones is 4.0 or less.

Tailhead

The tailhead is the area between the pin bones. As BCS increases, fat deposits change the shape and depth of the hollows between the pin bones and the tail itself. Does the indentation on either side of the tail base form a "U" or a "V" shape?



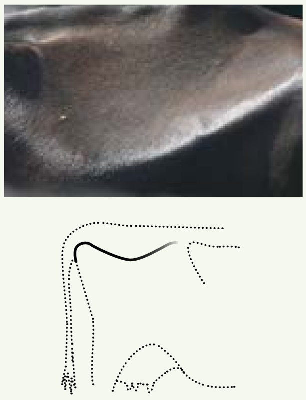
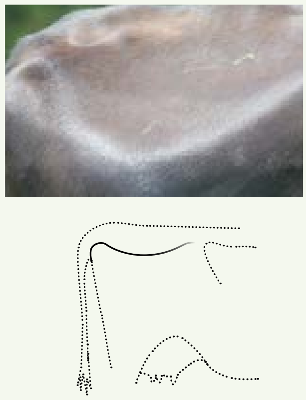
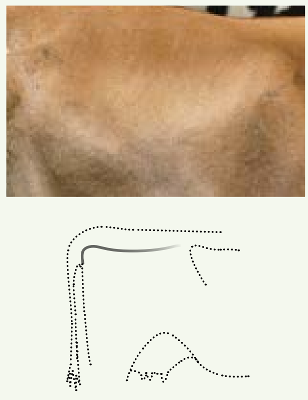
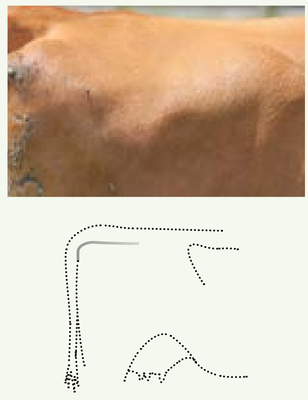
Use your fingers to feel the degree of indentation.

If the tail head feels like a shallow "U" shape, BCS for the tailhead is 4.0 or above.

If the tail head feels like a deep "V" shape, BCS for the tailhead is 3.0 or below.

Rump

The rump is the area between the hip bone and the pin bones. As BCS increases, this area fills from hollow to dished, then flattened to bulging and “beef” like. Is the area deeply sunken, hollow, or flat?

BCS 3.0	BCS 4.0	BCS 5.0	BCS 6.0
			

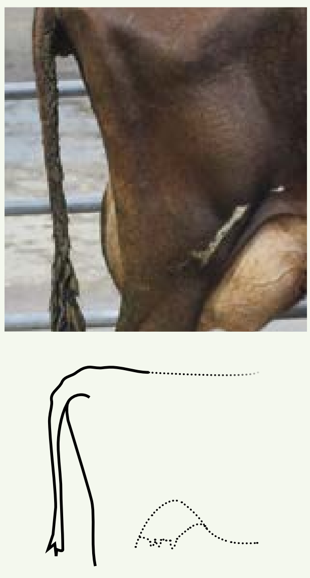
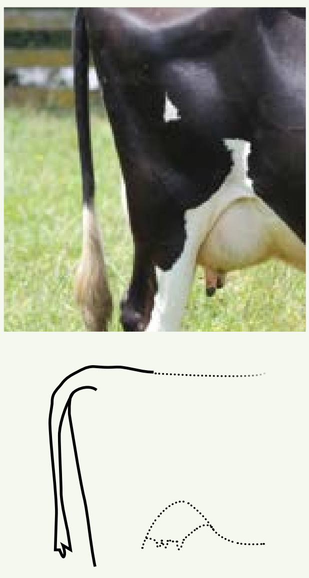
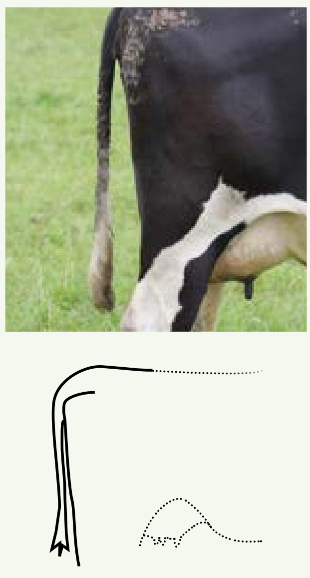
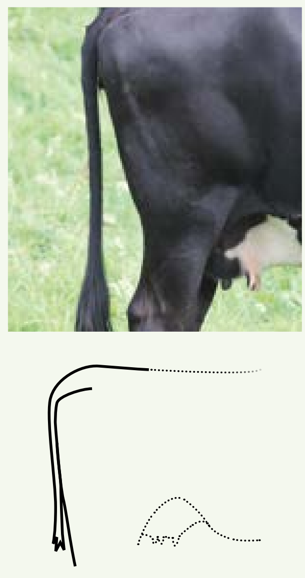
Draw an imaginary line from hip to pin bones following the contour of the rump.

Is the line flat, dished, or does it form an open “V”?

If the rump forms an open “V”, BCS for the rump is 3.0 or less.

Thighs

Best viewed from the side and rear of the animal, the thigh can be the hardest area to assess. As BCS increases, the areas below the rump and above the hocks fills out. Are they indented, flat or rounded?

BCS 3.0	BCS 4.0	BCS 5.0	BCS 6.0
			

If the muscle structure of the thigh is visible, BCS is less than 4.0.

Table 2. What to look for when body condition scoring – graphics

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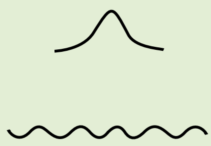
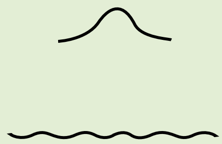
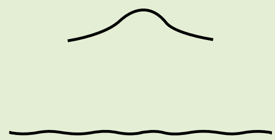
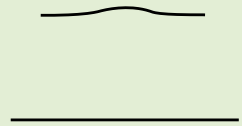
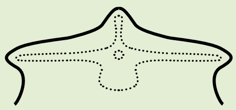
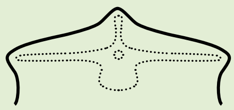
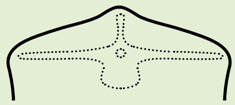
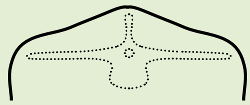
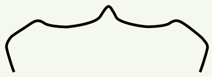
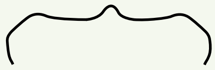
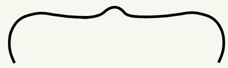
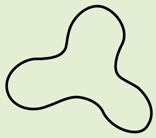
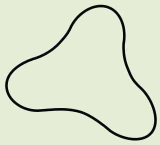
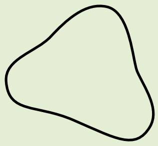
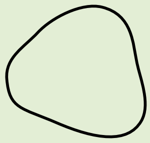
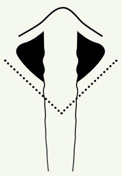
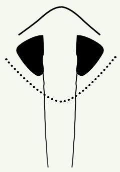
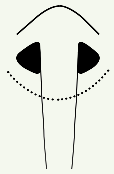
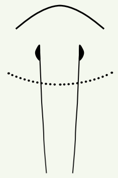
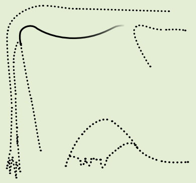
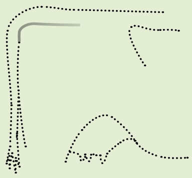
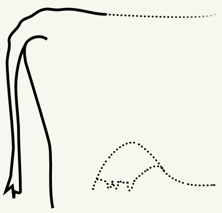
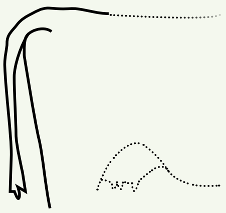
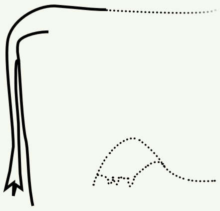
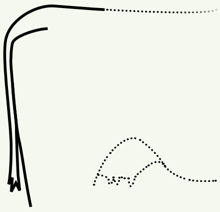
Backbone • Rear view • Side profile				
Long Ribs				
Short Ribs				
Hips				
Pins				
Tailhead				
Rump				
Thigh				

Table 3. What to look for when body condition scoring – descriptors

BCS	3.0	4.0	5.0	6.0
Backbone	Prominent ridge. Corrugations like "roofing-iron"	Ridge raised. Ridgeline, uneven and bumpy to touch	Ridge easily visible but rounded and smooth	Ridge forms a bump. Starting to round across the short ribs
Long Ribs	Four to five ribs easily seen	Two to three ribs visible but rounded. Ribs easily felt	Not visible but rounded to the touch	Well-rounded with fat cover felt
Short Ribs	Prominent with edges sharp to the touch	Individual ribs can be seen. Rounded at the ends	Rounded individual ribs not visible but can be felt	Rounded with fat cover felt
Hips	Angular, sharp edges. Depressions on sides appearing	No sharp edges (smooth). Flattened top	Rounded. Curved in profile	Rounded with fat cover starting to appear
Pins	Tap-like appearance. Sharp edges	Tap-like appearance. Rounded edges	Rounded	Well-rounded. Fat cover starting to appear
Tailhead	Deep "V" shape depression. Tailhead prominent, bumpy profile	Shallow "U" shape. Tail smooth. Base around tailhead is sunken	Tail rounded. Depression under tail filled. Even, no sharp edges	Fat cover starting to bulge
Rump	Deeply dished	Slightly depressed. Dished	Flat, even cover	Starting to round
Thigh	Indented. No visible fat. Muscle structure defined	Slight depression	Smooth and flat	Starting to round

Who should score cows

Farmers and rural professionals can score cows. But while body condition scoring is a simple process, it requires training, practice and regular calibration to ensure accuracy and consistency. Accurate and consistent BCS scores can then be used to support good management decisions, providing cows with the best chance to meet BCS targets and hence optimising production, health and welfare outcomes.

Scoring bias can also creep in when you are scoring cows that you see every day - an independent scorer can ensure this is avoided.

The best way to ensure independent, accurate and consistent body condition scoring using the DairyNZ method is to use a Certified BCS Assessor. Potential BCS assessors attend a training workshop and then complete an assessment. If successful, assessors are certified for 12 months. To remain certified, assessors must attend a formal calibration event every 12 months.

Recommended informal calibration process

It is essential for the scorer to ensure that they are consistent each time they score. Failure to regularly calibrate leads to variation in scoring. This can lead to poor management decisions.

For those not certified (and hence not regularly and formally calibrated) there are options to improve scoring accuracy:

- Use the DairyNZ Body Condition Scoring Made Easy field guide as a reference to confirm the score given.
- Score 10 to 15 animals "hands-on" in vet/AB race before herd scoring. "Hands-on" involves assessing each of the eight body parts of the cow as outlined above and in the DairyNZ Body Condition Score Made Easy field guide.
- Score cows alongside your certified vet/consultant and compare results.
- Use online resources - dairynz.co.nz/bcs
- Attend a DairyNZ BCS training workshop - dairynz.co.nz/bcs-events
- Consider becoming a Certified BCS Assessor - dairynz.co.nz/bcs-certification

When to score

The most important time to body condition score cows is during summer and autumn. This allows individual groups of cows to be managed differently (**Section 3 - Strategies to achieve targets**) to ensure BCS targets at calving are met.

A **pre-Christmas assessment** determines if cows have gained BCS since planned start of mating and a management plan for the autumn can be set up.

Assessing cows in **mid-February** to **mid-March** determines if the management plan is working or whether some cows should be dried off early, milked once-a-day (OAD) or preferentially fed.

Assessing BCS **pre-calving** (in springer mob) determines if the autumn management plan achieved the calving BCS targets and whether there is a need to re-assess management practices for next autumn.

An assessment of BCS at **planned start of mating** helps determine how much BCS cows lost between calving and mating. This will identify if getting cows back in calf is at risk as well as whether anything should have been done differently to prevent the BCS loss.

How many cows to score

This will depend on what you want to achieve. For much of the year an average BCS (and range) of the herd may be appropriate. The greater the percentage of animals assessed, the more accurate the result. However, for groups greater than 100 cows, a minimum of 70 cows should be scored when determining a herd average. These cows should be selected at random. With practice, scoring 70 cows will take less than 30 minutes.

Scoring all cows in the herd allows individual management and is most important during summer and autumn.

How to record scores

BCS Tracker app

The BCS Tracker app allows you to score cows on your smartphone and have ready access to the results. It also takes the hassle out of recording BCS data on paper and then transferring it to a computer.

It also allows you to:

- Calculate the average score for the herd, and store and review over time.
- Score multiple herds and create a report.
- Flag an individual cow and record her tag for later reference.
- Access the *DairyNZ Body Condition Scoring Made Easy*, when off-line.

For more information, **visit dairynz.co.nz/bcs-app**

DairyNZ BCS recording sheet

The DairyNZ BCS recording sheet can also be used. Blank sheets can be downloaded from **dairynz.co.nz/bcs-strategies**

This herd size =	126 cows						Date:	04-06-2011				
Condition score	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0		
		IIIII	IIIII	IIIII	IIIII	IIIII	IIIII	IIII				
		IIIII	IIIII	IIIII	IIIII	IIIII	III					
		III	IIIII	IIIII	IIIII	IIII						
			IIIII	IIIII	IIIII							
			IIIII	IIIII	IIIII							
			II	IIIII	II							
				III							Totals	
Number of cows		13	27	33	27	14	8	4			126	A
Total BCS		39	94.5	132	121.5	70	44	24			525	B
% of sample (Number of cows in BCS group ÷ Total Cows (A)		10.3%	21.4%	26.2%	21.4%	11.1%	6.4%	3.2%				

Average Condition Score:	Total CS	Divide by	Total Number of cows	=	Average BCS
	B 525	÷	A 126	=	4.2

Where to Score

Cows can be scored in different locations but there are pros and cons for each location.

Body condition scoring should be done from the rear right side to minimise the effect of rumen fill, which can reduce the visibility of long and short ribs on the left-hand side of the cow when her rumen is full. Note that extreme weather (e.g., wind, rain) will affect your ability to score accurately.

In a vet race

A vet race is the best location to provide an accurate BCS score, as you can get your hands on the eight body parts of the cow – ideal for calibrating. When scoring in a race, keep in mind the following points to maintain scoring accuracy:

- Cows need to be in single file, with the right side of the cow being unobscured (no distracting shadows, fences, gates, or other stock).
- Cows should be stationary, or moving very slowly, whilst being inspected for scoring.

This method is time consuming. It is good for learning and calibrating but not for scoring large numbers of cows.

In the paddock

Scoring in the paddock allows for more cows to be scored in a shorter period of time, and is a good option once you are more confident with the hands-on method (e.g. vet race). All of the eight body parts can be seen. When scoring, adapt to the flight distance of the herd being scored. If you are more than seven metres away from the cow being scored your accuracy is at risk. If the average flight distance of the mob/herd is greater than seven metres, then the BCS assessment should be conducted in another location. Take care not to score the same cow more than once; entering cow ID in the BCS Tracker app can help avoid this. It is difficult to score the whole herd in the paddock.

On the feedpad

Walking quietly behind cows as they feed on the pad can also be a useful location to BCS cows. Ensure you score cows from the right side of the cow to avoid the effect of rumen fill. This location may allow for scoring a large number of cows, provided they are settled and there is adequate space for the assessor to move without disturbing them.

In the farm dairy

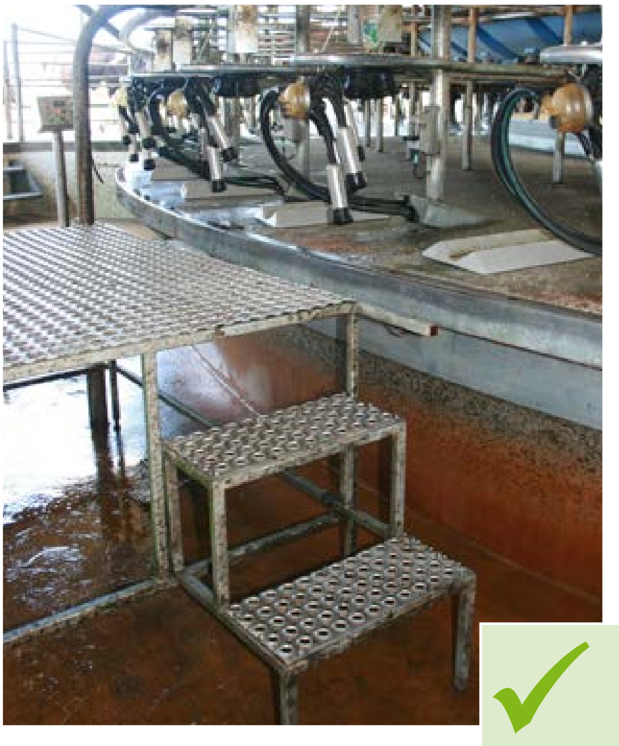
Scoring in the farm dairy can be a practical and convenient way to score large numbers of cows, however it is important to score from a position where you are at the same level or slightly above the cow being scored (e.g. while standing on a raised platform).

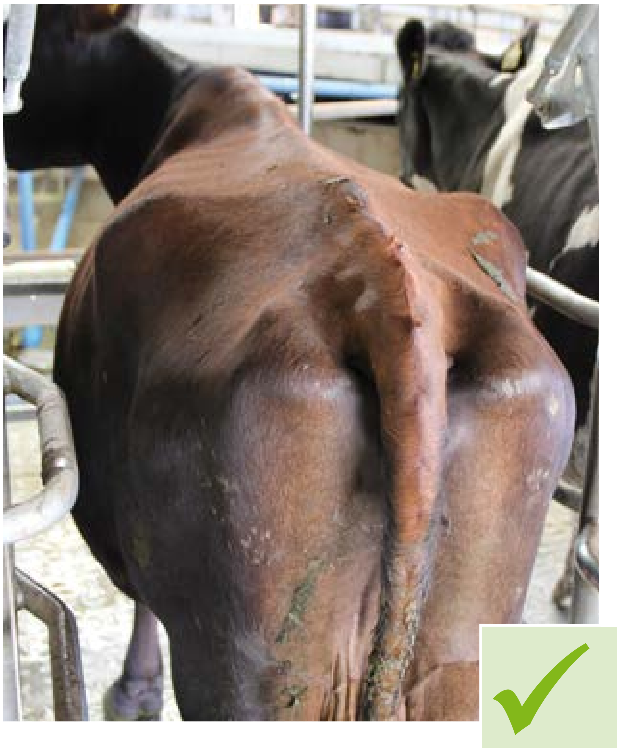
Scoring cows while they are in the bail can reduce the accuracy of scoring. In most situations the pit/bail configuration and presence of the rump and kick rail makes it difficult to see and assess all eight body parts required for body condition scoring. Inadequate lighting in farm dairies can also have a substantial effect on the ability to score accurately.

Rotaries

Scoring from a rotary milking platform is acceptable, provided the scorer is on a raised platform. From this position the scorer can view the pin bones, hip bones and tailhead and can make a reasonably accurate assessment of the backbone, short ribs and rump. The thighs and long ribs will be obscured to some degree by the rails. The rotary speed needs to be sufficiently slow to enable the scorer enough time to score each cow. If necessary the rotary should be stopped periodically to allow scoring as needed. It may be possible to score all cows in the herd in this location.

The limited view from the pit makes accurate BCS assessment difficult.





Herringbones

Scoring cows in a herringbone dairy without a mobile raised platform/trolley should be avoided, due to reduced accuracy.

However, cows of concern can be identified by standing at the cows' head and looking over the backline and making an assessment based on the backline, hip bones, short ribs and top of the long ribs. Once drafted into a race/yard, cows can then be accurately scored. If an average herd BCS is required, a random selection of cows can be drafted out into a race/yard and scored there. In general, it is not practical to score the whole herd in this location.

Animal welfare and BCS

As the person in charge of looking after animals, it is your legal obligation to ensure that any animal under your care meets the minimum standards outlined in the relevant codes of welfare, published by the New Zealand Ministry for Primary Industries. The information provided below outlines your obligation with regard to BCS.

Dairy Cattle Code of Welfare 2019 Minimum Standard No. 2 (b)

When the body condition score of any animal falls below 3 (on a scale of 1-10), urgent remedial action must be taken.

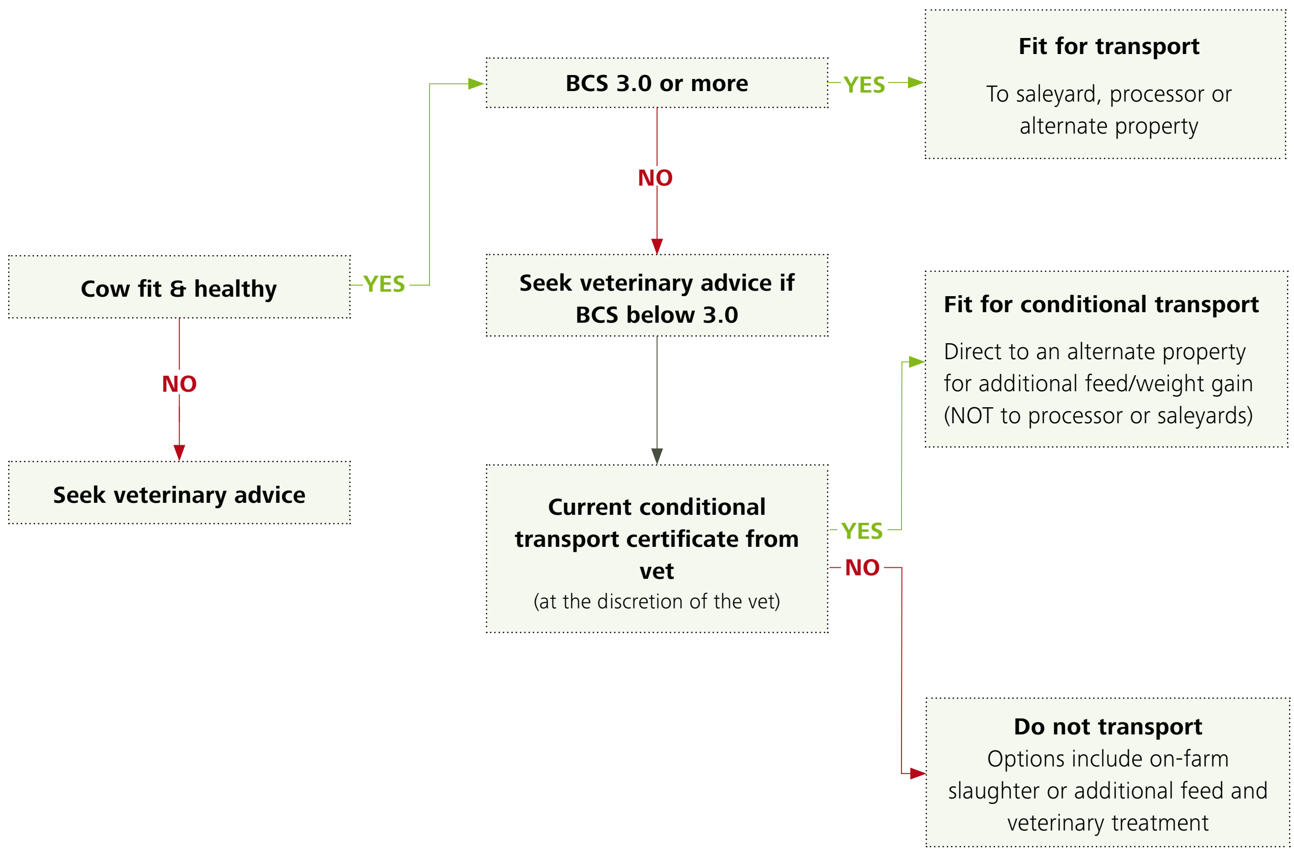
Urgent remedial action may include providing additional feed, seeking veterinary advice, or on-farm slaughter.

Note that animals below a BCS of 3 cannot be transported to a processor or saleyards. They can only be transported to an alternative property for additional feed with a current conditional transport certificate from a veterinarian. The flow chart below provides a guide about transport restrictions; it does not guarantee acceptance of livestock for transport or processing.

For further information on your obligations for pre-transport selection, refer to:

- **dairynz.co.nz/transport**
- *Dairy Cattle Code of Welfare 2019:* https://www.mpi.govt.nz/protection-and-response/animal-welfare/codes-of-welfare/

Transport restrictions based on BCS

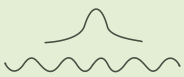
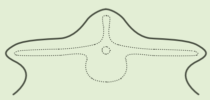
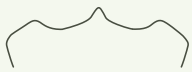
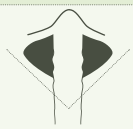
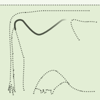
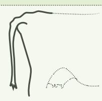


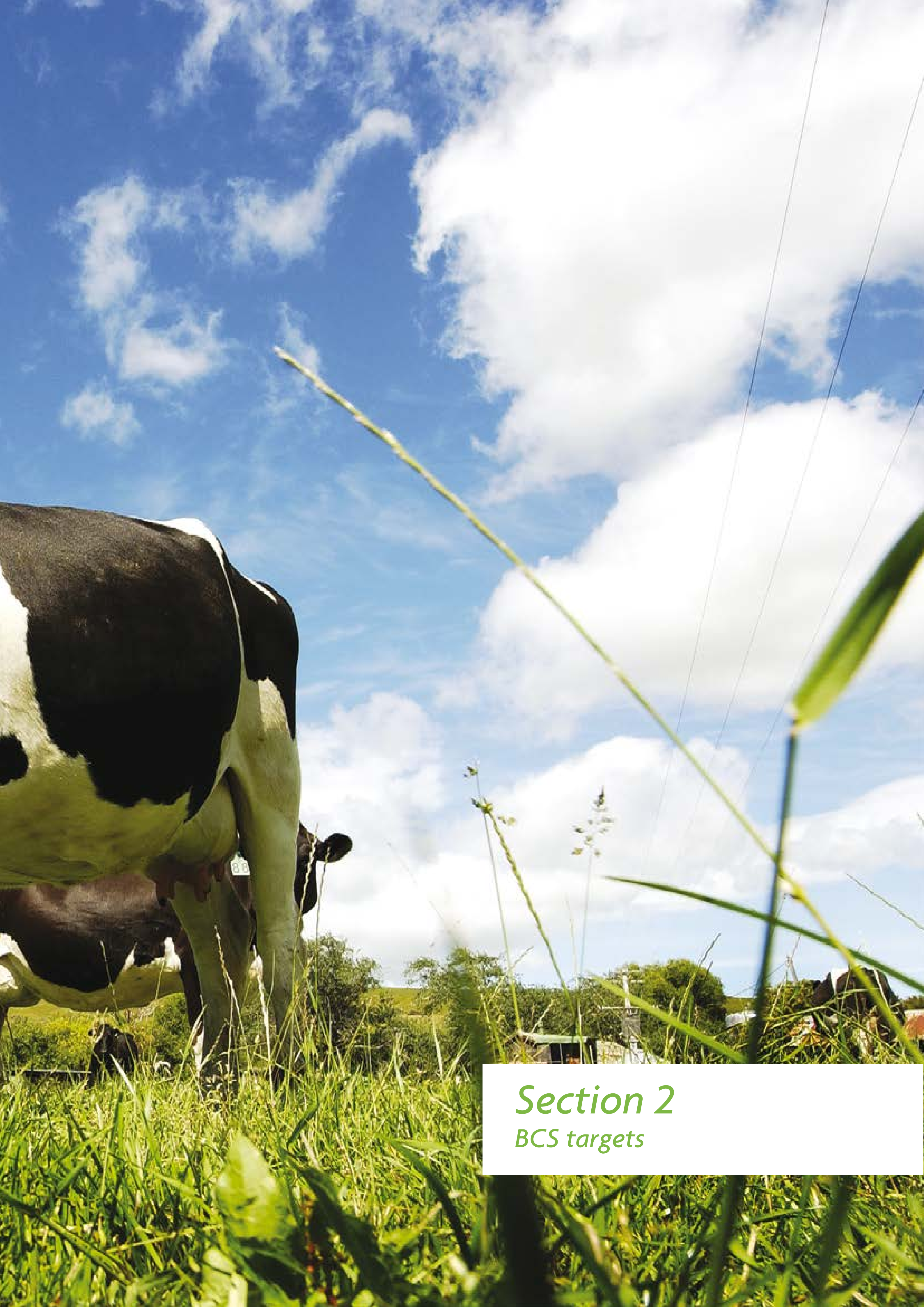
When to take action

Example of BCS 2.5

ANY COW WITH A BCS LESS THAN 3 REQUIRES URGENT REMEDIAL ACTION

Table 4. BCS 2.5 – what to look for

Backbone	Very prominent, with visible notches that can easily be counted.	
Long ribs	The long ribs may be visible as far down as the top of the udder.	
Short Ribs	Clearly visible and easily counted. The short ribs will have very sharp edges.	
Hip	Deep depressions on the side of the hip bone.	
Pins	Very clear, three pronged tap formation.	
Tailhead	Very prominent and angular, with a very deep "V" shape.	
Rump	Severely depressed (hollow).	
Thigh	No visible fat and very little muscle.	



Section 2
BCS targets

BCS targets

At calving

- Mature cows should calve at a BCS of 5.0.
- First and second calvers should calve at a BCS of 5.5.
- With not more than 15% of the animals greater than, and not more than 15% of the animals less than, these targets.

Note that first calvers (heifers) need to be at BCS 5.5 at 22 months of age. This requires monitoring the growth and health of youngstock, and a strategy to achieve targets, from weaning.

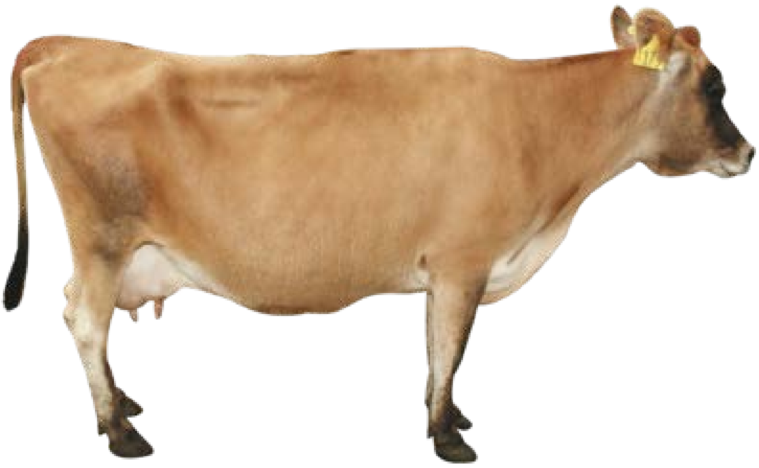
At mating

- Mature cows should be a minimum of BCS 4.0 at planned start of mating (PSM).
- First and second calvers should be a minimum of BCS 4.5 at planned start of mating.
- With not more than 15% of the animals less than these targets.
- The average decrease in BCS for the whole herd between calving and mating should not be more than 1.0 BCS unit.

Note that all animals should be gaining BCS before PSM.

For more detail, see the DairyNZ Body Condition Scoring Made Easy field guide.

Example of mature cow at BCS 5.0 (Target for calving)



Example of heifer at BCS 5.5 (Target for calving)

Example of mature cow at BCS 4.0 (Minimum at planned start of mating)

Why achieving BCS targets makes the difference

The BCS targets at calving represent the optimum "sweet spot", and have a large impact on dry matter intake, milk production, reproduction, and health post-calving. There are as many negative consequences of being below target BCS at calving as there are for being above target (**Figure 1**).

Figure 1. Summary of the consequences of cows being below or above target BCS at calving

Below Target

Reduced milk production

Reduced reproductive performance

Increased risk of infectious diseases risk as metritis and mastitis

Mixed age cows

BCS 5.0

1st & 2nd calvers

BCS 5.5

Optimal production, reproductive performance and general health

Above Target

Reduced dry matter intake

Increased BCS loss

Increased risk of metabolic diseases such as fatty liver, milk fever, ketosis

BCS at calving has the greatest influence on reproduction. Once cows have calved, it is very difficult to alter total, or rate of, BCS loss. Increasing feed allocation (pasture or supplements) does not impact on BCS loss until after 4-5 weeks of lactation. The main determinant of BCS loss after calving is BCS at calving, which is primarily influenced by feed and cow management in late lactation and during the dry and transition periods.

Decades of research in NZ and overseas has been used to define the body condition score targets at calving, which are:

- **Mature cows (four years and older) should be at BCS 5.0 at calving.**
- **Two and three year-old (first and second calvers) should be at BCS 5.5.**

These ensure that dry matter intake, milk production and reproduction are optimised, while minimizing the risk of health and welfare issues.

Why use different targets for younger cows?

BCS targets for first and second calvers are set 0.5 BCS units higher than for mature cows. This is because younger cows:

1. Tend to lose more BCS after calving as they are still growing to their mature weight and partition energy towards growth as well as lactation. Greater BCS at calving enables them to reach target BCS at mating.
2. Tend to have a longer anoestrus period after calving than older cows, which leads to later cycling and lower conception rates. Aiming for a higher body condition at calving helps to reduce this risk.
3. Are at a lower risk of metabolic disorders than older cows, so can tolerate calving at a higher body condition.

For more on ways to achieve targets, see **Section 3 - Strategies to achieve targets.**

For more on the science behind BCS targets, see **Section 4 - The science of BCS.**

Section 3
Strategies to achieve targets

How to achieve BCS targets

Four main strategies are used to help achieve BCS targets at calving. Choice of strategy will depend on the gains required for individual cows, and practicalities of managing a specific farm. These are:

1. Increase feed allocation to lactating cows
2. Reduce milking frequency in mid-late lactation
3. Dry-off cows early, and/or
4. Feed dry cows for BCS gain

Start managing BCS gain as early as possible, as once into late lactation, it becomes more difficult to significantly alter BCS.

Drafting cows into mobs, based on BCS, age, and expected calving date allows the right mix of approaches to be applied to cows with similar gains in BCS required.

References for this Section are provided in **Section 5 - Appendices.**

1. Increase feed allocation to lactating cows

Cows tend to preferentially partition energy to milk production at the expense of BCS during lactation. They also have higher energy demands compared to a dry cow, due to the

- 10-20% more energy required for maintenance, and
- 5-10% more energy required for walking and grazing activities.

Therefore, even in late lactation, providing additional feed to lactating cows will reduce/halt BCS loss, but is unlikely to cause significant BCS gain. Condition can be gained but will require more kg DM feed eaten than for a dry cow. If your pasture growth rates and covers allow, then increasing pasture allocation can be a cost-effective way of providing additional feed. Alternatively, supplementary feed can be used. The key focus when using supplements at this time of year should be on quality and cost, as the composition of supplement does not appear to affect BCS gain.

2. Reduce milking frequency in mid-late lactation

Once-a-day

Once-a-day (OAD) milking in mid-late lactation can be used to improve BCS at dry-off while achieving longer lactations. The strategy spares energy from activity (walking) and milk production and alters physiological processes towards BCS gain.

Previous OAD research in the Waikato has shown a 10-15% drop in daily milk production for herds that milked OAD for 2-3 months in mid-late lactation, compared with herds on twice a day (TAD) milking. As 60-70% of the season's production had occurred by this point, the impact on the whole season production is minimal (4-5%).

Milking cows OAD during this period improved energy status and BCS gain[1]. But there was only a minimal decline in dry matter intake during the period of OAD milking, and a small reduction in feed required during the dry period, to achieve target BCS.

The key to successfully using this strategy is to maintain a similar feed allocation to when cows were on TAD so there is energy available for BCS gain. If BCS gain is adequate, you may be able to increase lactation length and achieve similar total milk production as if cows continued to be milked twice-a-day.

For farms that have a set day for dry-off, regardless of conditions, the opportunity to extend lactation length to compensate for the lower production during OAD milking will be lost. This needs to be considered when planning for dry off.

Note that switching to OAD milking can increase the bulk milk somatic cell count (SCC) for a short period of time. Individual cow SCC can double for two to three days, so the bulk milk SCC must be able to accommodate this doubling, and not reach penalty levels. After a few days, the bulk milk SCC will drop back down to around 50,000 cells/ml above where it was previously. One solution is to remove high SCC cows from supply and dry them off early to reduce the risk of grading before switching to OAD.

For farms that can run multiple herds in their system, switching just one herd to OAD milking in mid to late lactation is a good option. Cows that have the greatest need to gain condition before calving, such as low BCS cows, early calvers, and rising three-year-olds, can be milked OAD in a separate mob. This leaves the rest of the herd, often including the high SCC cows, on twice a day milking. Cows milked OAD for three months in late lactation tend to have 0.25 BCS units more condition at dry-off than those milked twice-a-day, provided cows milked OAD are well-fed.

3 in 2 milking

Compared to OAD milking, milking 3 times in 2 days (3in2) can minimise the milk production losses associated with OAD milking while still reducing milking frequency. However, the additional energy available for BCS gain will be dependent on the farm situation.

For the latest information on milking frequency, see **dairynz.co.nz/milking-intervals.**

A 2019 DairyNZ study[2] examined the effect of 3in2 milking on production at different stages of lactation, using milking intervals of 12-18-18 hours. Preliminary results indicate only minimal production losses when implementing 3in2 (~5% total production for the period 3in2 was used), relative to the control cows milked TAD. This suggests limited additional energy available for BCS gain.

Cows milked 3in2 for the whole lactation were 0.25 BCS greater in May at dry off, compared to TAD milked cows. However, for cows milked 3in2 for shorter periods i.e., for the last three months in late lactation, there was a more limited effect on BCS gain, with cows gaining less than 0.1 BCS compared to cows milked TAD[2].

3. Dry off cows early

The length of the dry period required for cows to reach BCS targets at calving will be determined by

- The amount of BCS needed to be gained
- The amount of feed available
- The type of feed that will be offered during the dry period

The number of days dry, summarized in **Table 5**, provides a guide as to the length of dry period needed for cows of different BCS in late lactation to reach BCS targets by calving. These calculations account for the 30-40 days in the dry period where no net BCS gain occurs.

Table 5. Drying off time based on cow BCS and time to calving to achieve target calving BCS

Body condition score		Days cow needs to be dry before calving	
Mature cow	First & Second Calvers	Autumn pasture with limited supplements or crops	Autumn pasture and/or high-quality crops supplement fed above maintenance)
3.0	3.5	160	120
3.5	4.0	130	100
4.0	4.5	100	80
4.5	5.0	70	60
5.0	5.5	42*	42*

Includes 10 days when cows are being dried off and not gaining BCS, and 30 days when cows do not gain BCS before calving.

*DairyNZ recommends a minimum dry period of 42 days for all cows irrespective of BCS.

Drying off early those cows at-risk of not achieving body BCS targets involves trading off autumn milk production to reach BCS targets before the winter. However, the milk foregone in the autumn is approximately equal to the production gained the following spring, so there is usually no net change in milk revenue.
Financial gains from improved BCS come from improved reproduction and milk production. The figures for your herd can be calculated using the InCalf Gap Calculator. Available from **dairynz.co.nz/incalf.**

There are additional benefits for cows calving at target BCS that cannot be easily valued economically, such as resilience of the system in a difficult spring and reducing the number of very thin cows on the farm.

The simplest way to operate this strategy is to use a staggered approach to dry-off, targeting lower condition and/or younger cows for early dry-off, based on the guide in Table 5. Dry off dates for cows at different BCS can be calculated using the BCS Dry-Off calculator. See **dairynz.co.nz/bcs-strategies.**

4. Feed dry cows for BCS gain

Typically, a dry cow uses energy less efficiently than a lactating cow for BCS gain, requiring 72 MJ ME to store 1 kg LWT, compared to 50 MJ ME for a lactating cow.

But a dry cow tends to gain more BCS per unit of feed eaten, compared to a lactating cow because she does not have the same energy demand of milk production and has lower activity and maintenance requirements compared to a lactating cow. So, more energy is available to be partitioned towards BCS gain.

For example, feeding a lactating cow 3kg DM concentrate per day for 100 days during mid or late lactation would increase her BCS by approximately 0.12 BCS units. In comparison, feeding 3kg DM concentrate per day to a dry pregnant cow, for 60 to 100 days pre-calving, would increase her BCS by 1.0 BCS units.

During the dry period, **time available**, and the **type of feed** offered are the two key drivers of whether a cow will reach BCS targets at calving.

For early dry-off to be successful, cows must be allocated enough energy through the dry period to support maintenance, pregnancy, activity, cold stress (if applicable) and BCS gain. This will be a minimum of 9-11 kg DM/day, depending on breed.

Time available

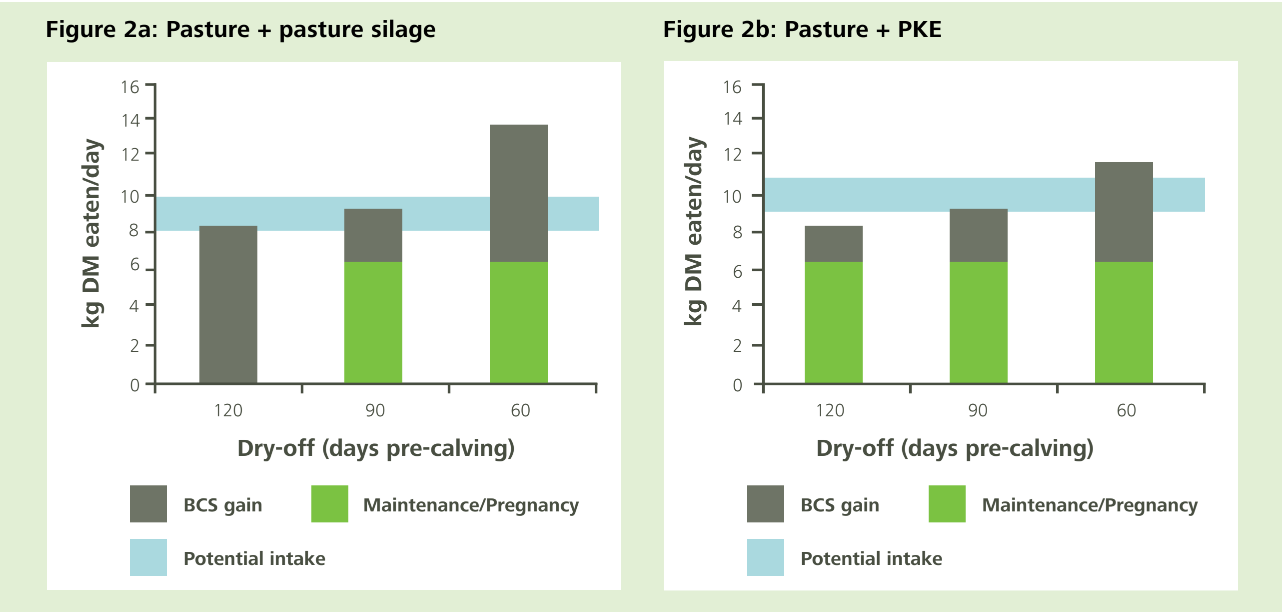
The most common reason for not reaching BCS targets is not allowing enough time. Remember that:

- Cows rarely gain BCS in the first one to two weeks after drying off. Sometimes they even lose BCS during this period because the active immune response involved in the drying off process in the udder has a high energy demand, and feed is often restricted to cows during this period to reduce milk production.
- Dry cows gain very little BCS in the last month before calving (less than 0.1 BCS units). This is due to the large energy demands and inefficient use of nutrients by the growing calf.
- On average, cows will only gain 0.5 BCS per month during the dry period if fed a pasture-based diet, and 0.6 – 0.7 BCS units per month if fed a diet containing high levels of supplement or high energy crops.

Figures 2a and **2b** show how the **time available** and the **type of feed** offered during the dry period influence the cow's ability to reach BCS targets[3, 4]. Each scenario shows the amount of feed required each day to provide for maintenance and pregnancy while gaining one BCS unit over the dry period, for a 450 kg crossbred cow.

- If a long-enough dry period is provided i.e., 120 days or 90 days, a dry cow can consume sufficient feed to meet her maintenance and pregnancy requirements and to gain 1.0 BCS unit (**Figure 2a**). But if only a short dry period i.e., 60 days, is provided, daily intake requirements are greater than the amount she can typically consume (blue zone). Supplementing with a higher DM feed such as PKE (Figure 2b) can increase the amount of energy she can consume but still won't overcome a dry period that is too short.

Figures 2a and 2b. Daily feed intake required (green bars) to meet maintenance and pregnancy requirements (light green), as well as gain one BCS unit (dark green) in the dry period for a 450 kg crossbred cow, for different lengths of the dry period. The blue zone represents actual daily feed intakes that a dry cow can consume[3, 4].



Type of Feed

Energy in autumn pasture is used less efficiently for gaining BCS compared to energy from other feeds such as pasture silage, maize silage and palm kernel extract (PKE). Pasture and maize silage are used with 20% more efficiency, while PKE is used with 40% more efficiency than autumn pasture[3].

The feed requirements (kg DM) for 1.0 BCS unit gain from different feeds are summarised in Table 6.

The reason why different feeds have different effects on BCS gain is currently not known, but the results are based on feeding studies in New Zealand.

Note that feeding PKE to dry cows does not affect the FEI, so can be used through the dry period with no milk quality restrictions.

Table 6. Approximate amounts (kg DM) of 'commonly used feeds' required for a 1.0 unit increase in BCS for dry cows[3, 5].
These are average feed requirements above the needs for maintenance, activity and pregnancy.

Breed	Kg Lwt*	Kg Lwt/BCS	Autumn Pasture	Pasture Silage	Maize Silage	PKE
Typical energy content of feeds (MJ ME/Kg DM):			**11.5**	**10.5**	**10.5**	**11**
			—— Total Kg DM of feed required ——			
Jersey	350	23	145	110	115	85
Jersey	400	26	165	130	130	100
Crossbred	450	30	185	145	145	110
Holstein Friesian	500	33	205	160	160	125
Holstein Friesian	500	36	225	180	180	135

*Live weights are for the cow only and exclude the weight of the foetus.

Note that:

- The differences between maize silage, PKE and pasture silage are not statistically significant, which means we cannot say with full confidence that the numerical difference is real, however this is the best information available for NZ farmers.
- The daily amount of feed required during the dry period will differ, with greater intakes required later in pregnancy.
- Realistically, cows do not gain BCS during the last month before calving because of the energy demands of foetal growth.

Other considerations

The practicalities of feeding and managing dry cows will affect the success of achieving BCS targets at calving.

Feed wastage

Wastage needs to be accounted for when determining the amount of feed to offer. The way that a supplement is fed, such as on a feed pad or along the fence line, affects wastage. Rules of thumb for different ways to offer supplements results in these utilisations:

- In-shed feeding facility = 95% utilisation
- Feed-pad = 90% utilisation
- Trailer in paddock = 85% utilisation
- Silage on ground = 80% utilisation (dry conditions) to 60% utilisation (wet conditions)

Mob Management

To achieve BCS targets, it is important to manage cows according to their needs. For herds with a range of BCS, manage cows in different mobs so that some cows do not become over-conditioned, while others fail to reach target. Cows that are very light at dry off (BCS 3.5 or less) may require preferential treatment, such as:

- Are the cows in poor condition for reasons other than feeding e.g., lameness, facial eczema, mineral deficiency, parasites, infection, disease, etc? If in doubt get the animals checked by a veterinarian.
- Can their energy needs be further reduced, or access to allocated feed be made easier, by running them in a smaller mob to reduce competition?
- Can they be offered a high-quality feed that is more efficient for BCS gain e.g., PKE, which can be fed ad-lib to dry cows? (Refer to DairyNZ Facts and Figures for NZ Dairy Farmers, pages 65-80 for more information).
- If feeding pasture, can they be fed to more generous grazing residuals (i.e., greater than 4 cm or 8 clicks on the rising plate meter)?

Winter grazing

Winter grazing can be used to achieve BCS targets, but care must be taken to ensure:

- Cows have access to enough good quality pasture to gain desired BCS (Table 6, page 39).
- The quality of winter grazing is assessed. If the feed is low quality (kikuyu or browntop) or feed utilisation is poor, BCS gain will be less than predicted.
- Cows are monitored throughout the dry period and fed differentially, if needed, to ensure all cows reach targets.

Winter grazing does have other benefits, especially if the milking platform is wet, by reducing pugging damage and protecting future pasture growth.

Wintering on crops (e.g. kale, swedes, fodder beet)

Winter crops are generally considered an economical option for feeding cows to gain BCS in regions where pasture growth is insufficient to meet cow demand during winter (e.g., South Waikato, Central Plateau, Canterbury and Southland). Swedes, kale and fodder beet have been the primary crops used.

Studies in NZ[6] reported no difference in the final BCS of cows between different crops, when crops were allocated on a MJ ME basis, and efficiency of utilisation was allowed for.

- Transition onto the crop
- Access to, and utilization of the crop
- Required supplements (e.g., minerals, fibre)

For more details on best practice use of crops see **dairynz.co.nz/crops**

Determining accurate dry matter yields and allocating crop correctly remain the key factors influencing successful wintering on crops

Transition cow feeding

In the last two to three weeks before calving, different strategies should be implemented for cows that are at target, and for those that are not at their correct BCS target.

For cows that are under target:

- Continue feeding to 100% of their requirements, to better support their immune system during calving and maximise their chances to gain condition up to calving.

For cows that are at, or above, target:

- Restrict their energy intake to 90% of their requirements, to minimise the risk of metabolic problems occurring during and after calving.

These approaches are summarised in **Table 7.**

Table 7. Metabolisable energy (ME) and approximate dry matter intake (DMI) requirements for last 2-3 weeks before calving.

Cows less than BCS 5.0 100% of daily requirement			Cows at or greater than BCS 5.0 90% of daily requirement		
LWT	ME requirements	DMI requirements*	LWT	ME requirements	DMI requirements*
350	85	7.7	350	76	6.9
400	94	8.5	400	84	7.6
450	102	9.3	450	92	8.4
500	111	10.1	500	100	9.1
550	119	10.8	550	107	9.7

*** ME = 11 MJ/kg DM**

Note that the DMI figures in Table 7 are 'down the throat' figures and allowances need to be made for wastage of pasture and supplements. For example, a 450 kg cow at BCS 4.5 would require 9.3 kg DM daily down the throat. If cows were grazing and pasture utilisation was 90%, they would need to be offered 10.3 kg DM daily.

Summary

The BCS targets for calving are for individual cows, not the herd average.

The different strategies, or combinations of strategies, that could be implemented will depend on the farm system, infrastructure, personal preferences, region, climate, soil type, and feed demand/supply.

If there is a range of BCS within a herd, a mix of these strategies may be necessary to achieve BCS targets for all cows.

Key aspects to note when planning are:

- Cows gain little, if any, BCS in the one to two weeks after dry-off and in the month before calving.
- On average, cows gain 0.5 BCS per month if fed pasture or pasture silage, and 0.6 BCS units per month if fed a diet containing high levels of supplement or high energy crops.
- Cows on winter crops gain approximately 0.5 BCS units per month, but this will depend on management of the different crops. Remember cows need time to adjust to a crop before they will gain BCS.

Section 4
The science of BCS

BCS targets – a balancing act

The pre-calving BCS targets of 5.0 for mature cows and 5.5 for first and second calvers aim to:

- Optimise dry matter intake.
- Optimise milk production and reproduction.
- Minimise risk of health and welfare issues around calving and during lactation.

This section looks at each of these factors in isolation, but the interactions between them need to be considered as they occur on farm. This section provides the background of how the targets have been derived, and their relevance in supporting a successful system.

NB References for this Section are provided in **Section 5 - Appendices.**

Impact of BCS

1. BCS and dry matter intake

Fatter cows graze for less time than thinner cows after calving. Therefore, the greater the BCS at calving, the lower the DMI and the greater the loss of BCS (negative energy balance) post-calving[1].

This is due to hormones acting on the brain that reduce the cow's drive to eat. As a result, fatter cows at calving are at greater risk of ketosis, fatty liver, and milk fever (see BCS and health, **page 48**)

As calving BCS establishes the profile of BCS change throughout lactation, it can have lactation-long implications for cow dry matter intake. Data from grazing cows in New Zealand suggests that for every 1 unit increase in BCS at calving, cows consume 0.5-1kg DM less per day after calving.

Analysis of cow behaviour shows that the reduction in dry matter intake in fatter cows was due to less time spent grazing and more time spent lying. When cows were grazing, the rate of eating (kg DM/hour; a welfare indicator of hunger) was not affected. Fat cows are less hungry after calving.

The negative effect of BCS on DMI is the same, whether the increased BCS is a result of cow genetics or management[1].

- If cows are naturally thin (genetics), they have a greater drive to eat.
- If cows are thin because of an earlier shortage of feed (management), they have a greater drive to eat.

Achieving target BCS at calving is a compromise between:

- wanting cows with sufficient energy reserves for milk production and fertility outcomes,
- while not being too fat, which reduces intake and increases risk of metabolic disease after calving.

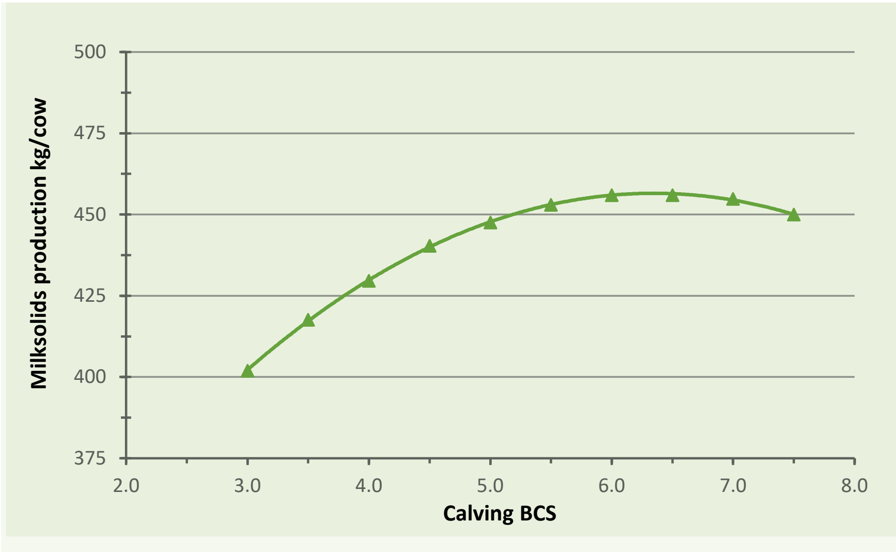
2. *BCS and milk production*

The loss of BCS and mobilised body tissues in early lactation provides fatty acids for milk fat synthesis and amino acids for milk protein synthesis. Due to the greater loss in BCS in fatter cows, milk fat and protein yields increase with increasing calving BCS, up to BCS 6.5

The increase in milksolids production gets smaller as BCS at calving increases (Figure 3)

- An increase in calving BCS from 3.0 to 4.0 increases milksolids production by 17 kg/cow
- An increase in calving BCS from 4.0 to 5.0 increases milksolids production by 12 kg/cow
- An increase in calving BCS from 5.0 to 6.0 increases milksolids production by 6 kg/cow

Figure 3. Relationship between BCS at calving and annual milksolids production[2]



Data for these associations were estimated from 2,500 lactation records, collected from almost 900 cows2, managed under tightly controlled grazing management systems. Associations were modelled between BCS at calving and BCS changes after calving with milk fat and protein production in the following lactation.

To optimise milk production, reproduction and health, cows should calve at a BCS of 5.0 (5.5 for two-and three-year-olds) and the BCS loss between calving and mating should be limited to a maximum of 1.0 BCS.

3. BCS and reproduction

Fertility is affected[3] by

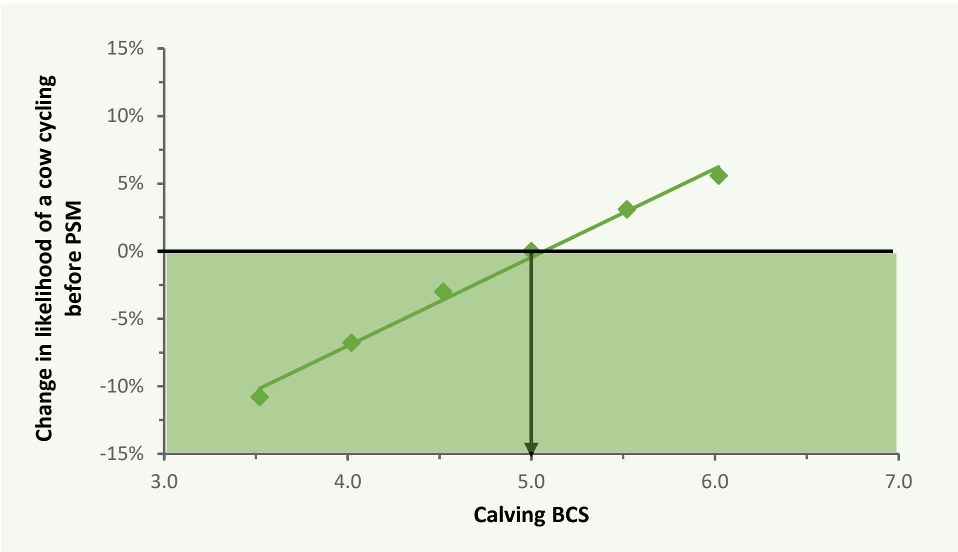
- BCS at calving,
- BCS at planned start of mating (PSM),
- loss of BCS in early lactation, and
- whether cows are gaining Lwt before and during mating.

These relationships are based on analysis of 2500 whole-lactation records, collected from almost 900 cows[3] managed under tightly controlled grazing management systems over a number of years. Associations were modelled between BCS at calving, BCS changes after calving, and various reproductive outcomes in the following lactation.

Thinner cows at calving cycle later

- A cow that calved at BCS 4.0 was less likely to have a pre-mating heat recorded than a cow calving at BCS 5.0 (Figure 4).

Figure 4. Relationship between calving BCS and the likelihood of cows cycling before planned start of mating (PSM)[3].



Limitations of the dataset

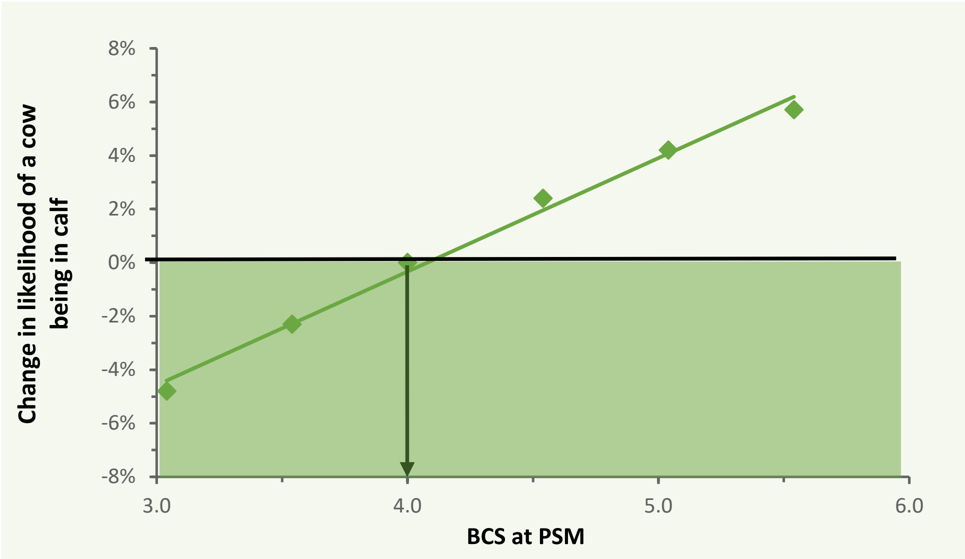
- Only small numbers of cows were at a BCS below 3.5 or above 6.0 at calving. For this reason, the relationship for data within the 95% confidence interval is shown for Figures 5, 6, and 7.
- Less than 5% of the cows were at a BCS of 6.0 or over at calving, so the health and reproductive consequences for animals above target BCS are not well represented.
- Animals were removed from the herd due to health problems, potentially resulting from high or low BCS. This means

that the full impact of BCS at the extremes on fertility and animal health may not be fully represented.

Thinner cows at PSM have lower pregnancy rates

- A cow at BCS 3.0 at PSM was less likely to get in calf in the first six weeks of mating than a cow at BCS 4.0 at PSM (**Figure 5**).

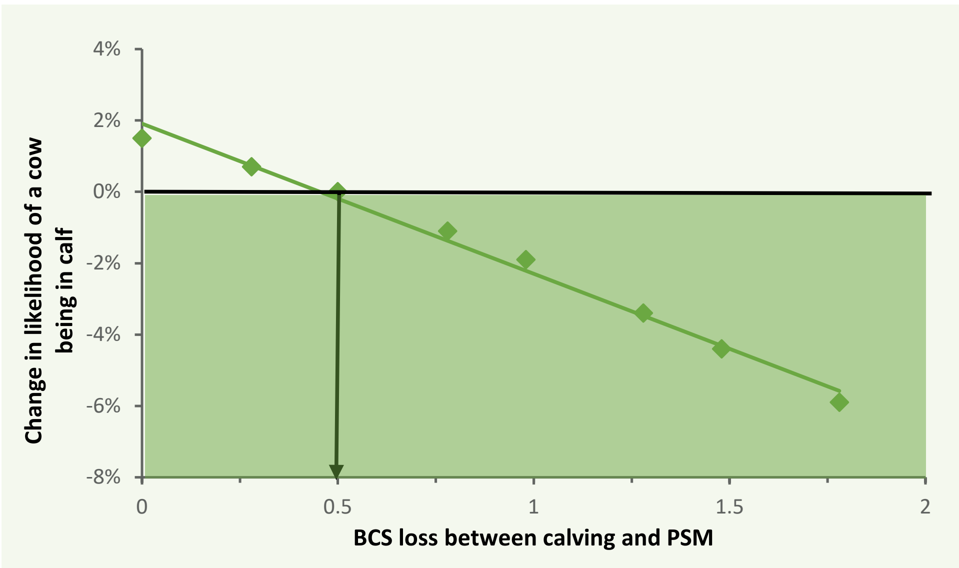
Figure 5. Relationship between calving BCS and the likelihood of cows cycling before planned start of mating (PSM)[3].



Cows that lose more BCS in early lactation have lower pregnancy rates

- Cows that lose 1.0 BCS units after calving were less likely to get in calf in the first six weeks of mating than cows that lose 0.5 BCS unit (Figure 6).

Figure 6. Relationship between BCS loss between calving and mating and likelihood of a cow being in calf in first 6 weeks of the mating period[3].



Cows gaining liveweight (Lwt) during the breeding period are more likely to get pregnant, but this effect is small

- Doubling Lwt gain from 0.2 to 0.4 kg/day during breeding only increased 6-week and 12-week in-calf rates by less than 1%[3]. This equates to lifting BCS gain from 0.25 units/month to 0.5 units/month.

Important points

- Many factors affect reproduction. Body condition is just one of these factors. If your herd's reproductive performance is less than industry targets, use the InCalf Herd Assessment Tools to assess the value of closing the gaps for your herd. Go to **dairynz.co.nz/incalf** to find out more.
- Management and/or nutrition have very little effect on BCS loss for the first four to five weeks post-calving.
- Fatter cows at calving cycle earlier but thinner cows lose less BCS after calving. The key is to optimise the benefits of these drivers by calving cows at a BCS of 5.0.
- Younger cows (rising two and three-year-olds) should be 0.5 BCS units fatter than mature cows at calving to optimise reproductive performance

To optimise pre-mating cycling and 6-week in-calf rates, cows should calve at a BCS of 5.0 (5.5 for two and three year olds). This will also help limit the BCS loss between calving and mating to no more than 1.0 BCS unit[3].

4. BCS and health

The effects of calving BCS and BCS in early lactation on animal health are inconsistent and depend on the aspect of animal health being considered[4, 5].

- Metabolic disorders that occur around calving are more prevalent when cows are fat at calving (greater than BCS 6.0), although the risk of milk fever is greater in both fat (greater than BCS 6.0) and thin (less than BCS 3.5) cows.
- The risk of ketosis doubles when calving BCS in mixed aged cows increases from 5.5 to 6.0.
- Calving BCS or change in BCS before calving does not affect the risk of calving difficulty or a stillbirth.
- A difficult calving results in greater BCS loss post-calving.
- Studies have shown that thinner, young cows at calving are more likely to have mastitis and uterine infections in early lactation[6]. The same effect was not evident in mature cows.

There is evidence from more intensive production systems that both low body condition score and loss of body condition score are risk factors for the development of lameness, principally sole and white line disease. Whilst this work has yet to be replicated to the same extent in pasture-based systems, it is likely the same underlying mechanisms would apply in New Zealand conditions. Limiting the rate and extent of body condition score loss may play a role in lameness prevention management on farm[7].

These data are supportive of BCS targets for first and second calvers being higher than mature cows.

To reduce the risk of animal health issues during early lactation, cows should calve at a BCS of 5.0 (5.5 for two-and three-year-olds)[8, 9, 10, 11].

5. BCS and other important traits

Body condition score at calving and in early lactation can influence other traits that are important to the profitability and sustainability of the farm system.

- Fatter cows at calving are more likely to give birth to a heifer calf the following year[12]. Every unit increase in BCS at calving increases the probability of a heifer calf in the future by approximately 5%.
- Heifers born to cows that lose excessive BCS during early lactation produce less milk and have reduced reproductive capacity[4].

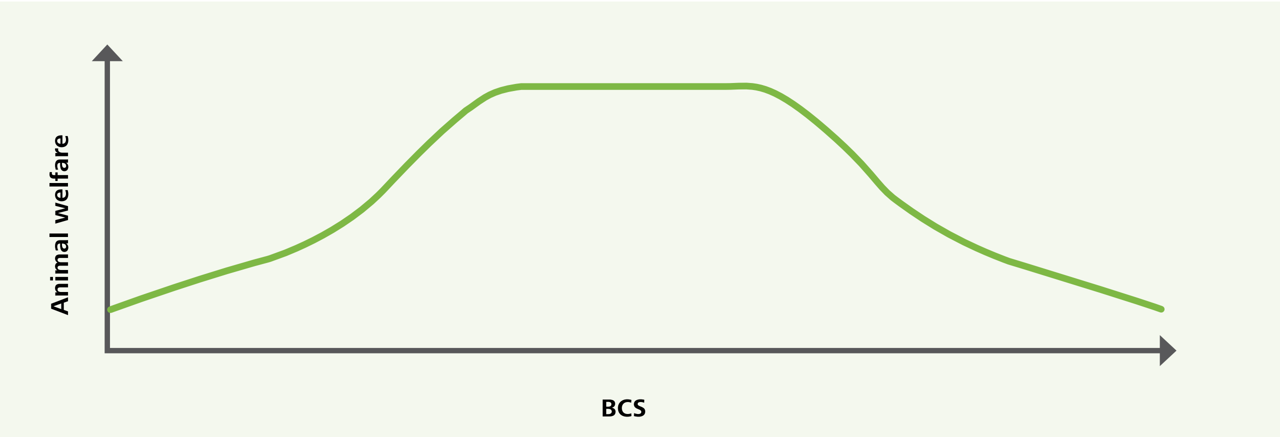
It is therefore important that a cow is sufficiently fat at calving to maximise replacement heifers, but not so fat as to undermine the productive and reproductive ability of those heifers.

6. BCS and dairy cow welfare

Animal welfare is a complex and emotive area[13, 14].

High and low BCS pre-dispose cows to diseases, metabolic disorders, low productivity, and low reproductive function, all of which imply compromised welfare (Figure 7).

Figure 7. A stylised relationship between animal welfare and body condition score[4].



What is defined as high or low BCS will vary with time of year (e.g. a BCS of 3.5 would be very thin at calving but is less concern for welfare at peak lactation). However, the same BCS targets that optimise productivity ensure animal welfare requirements are met.

Animal welfare reflects the needs of the individual animal and not the herd. Therefore, adhering to animal welfare requirements involves managing the herd to ensure the welfare of an individual cow is not compromised. The range of BCS within a herd is, therefore, as important as the average BCS of the herd.

The *Dairy Cattle Code of Welfare 2019* has identified a minimum acceptable standard of BCS 3.0.
https://www.mpi.govt.nz/protection-and-response/animal-welfare/codes-of-welfare/

The range of BCS within a herd is as important as the average BCS of the herd.
When the BCS of any animal falls below 3.0, urgent remedial action must be taken to improve BCS.

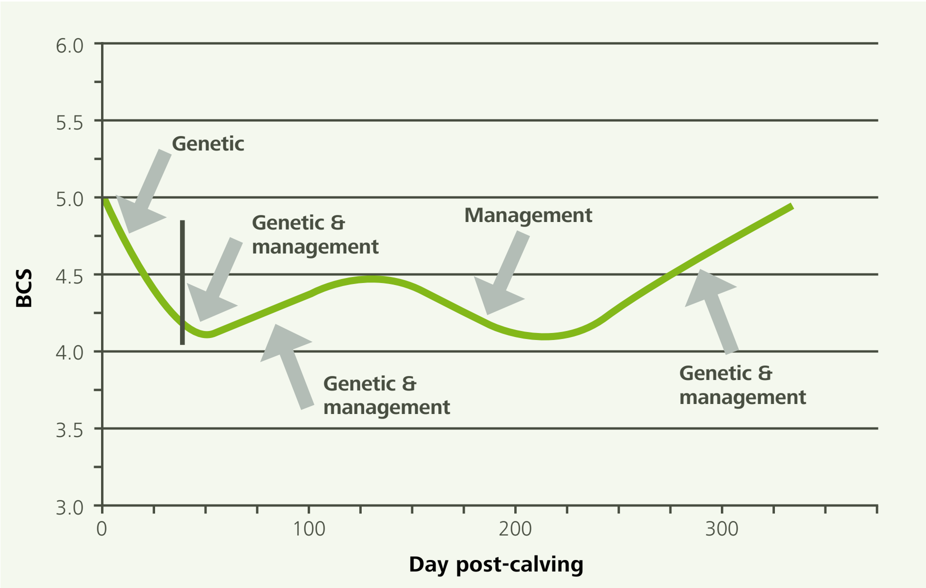
Factors that affect BCS

1. Time from calving

In pasture-based systems, the profile of BCS change through lactation is generally in the shape of a 'W'. Figure 8 highlights when genetics and/or management can have an impact on the BCS of a cow during the season.

Figure 8. Typical profile of BCS change in a pasture-based system[15]

The black vertical line signifies the point at about 4-5 weeks after calving, when the factors that influence BCS change from wholly genetics to a mix of genetics and management.



The profile of change differs for younger compared to older cows, and for stage of lactation and pregnancy.

First calvers typically calve in better condition than mature cows but take longer to gain the same amount of condition at the end of the season. They need to be dried off earlier than mature cows and need preferential feeding to reach their target calving BCS of 5.5 for their second calving[4].

Early lactation

Cows are genetically predisposed to lose BCS for the first 50 to 100 days after calving as cow energy intake is less than cow energy requirements. During this period cows are in a natural state of negative energy balance and mobilise body reserves to support maintenance, activity, and milk production. The amount of BCS mobilized during this period is influenced by BCS at calving, cow genetics and, after approximately 4 -5 weeks, management factors.

Mid lactation

Approximately 8-10 weeks after calving, cow dry matter intake peaks, and energy intake matches energy demand. At this stage, cows enter into a positive energy balance and stop mobilising body reserves. This is known as BCS nadir (the lower point of BCS). The rate of change of BCS after nadir depends on genetics and management factors.

Late lactation

After approximately 200 days in milk, cows require energy for pregnancy in addition to maintenance, activity, and milk production. During this period, cows start to partition more energy towards BCS. The amount of BCS gained during this period is influenced by cow genetics and management factors.

Non-lactating (dry) cows

A dry cow uses energy less efficiently than a milking cow for BCS gain, but she does not have the same energy demands for milk production, maintenance, or activity. Therefore, she partitions more energy towards BCS and will gain more BCS per unit of feed eaten (see **page 37** for more on feeding dry cows for BCS gain).

The energy demand of pregnancy increases as the cow nears her calving date, such that in the last month before calving, a cow will gain minimal BCS as most of the energy is partitioned to the developing foetus.

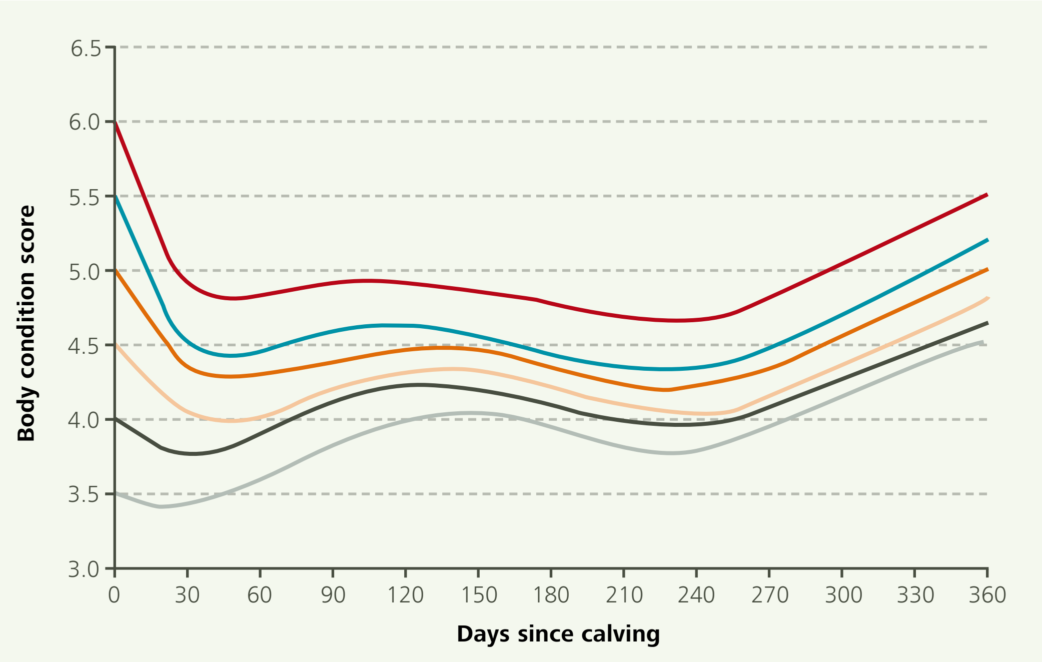
2. BCS at calving

Body condition score at calving alters the amount of BCS lost post calving, and therefore influences the BCS that is achieved pre-mating and throughout the season (Figure 9).

Note that cows calving at BCS 5.0 tend to return to the same BCS for the next calving. First calvers are an exception to this (see previous **Section 3 - Strategies to achieve targets**).

Reaching BCS targets at calving gives your cows the best chance of reaching targets during the season.

Figure 9. Pattern of BCS change for cows calving at different condition scores on research herds in the Waikato[15].



Not all cows will change **BCS** in the same way when fed the same diet. Cows selected for greater milk production will partition energy towards milksolids at the expense of body condition, resulting in lower BCS throughout lactation[16, 17].

From these and other studies, we find that

- Cows that are above BCS targets at calving lose more BCS and are at a greater risk of metabolic diseases such as milk fever and ketosis.
- Cows that are below BCS targets at calving lose less BCS after calving but reach a lower BCS nadir (lowest point) and are at a greater risk of infectious diseases such as metritis and mastitis.

BCS at calving is the biggest driver of BCS loss after calving and BCS at mating[4].

3. *BCS and genetics*

Up to 60% of the variation in BCS within a herd can be due to the genetic makeup of the cows.

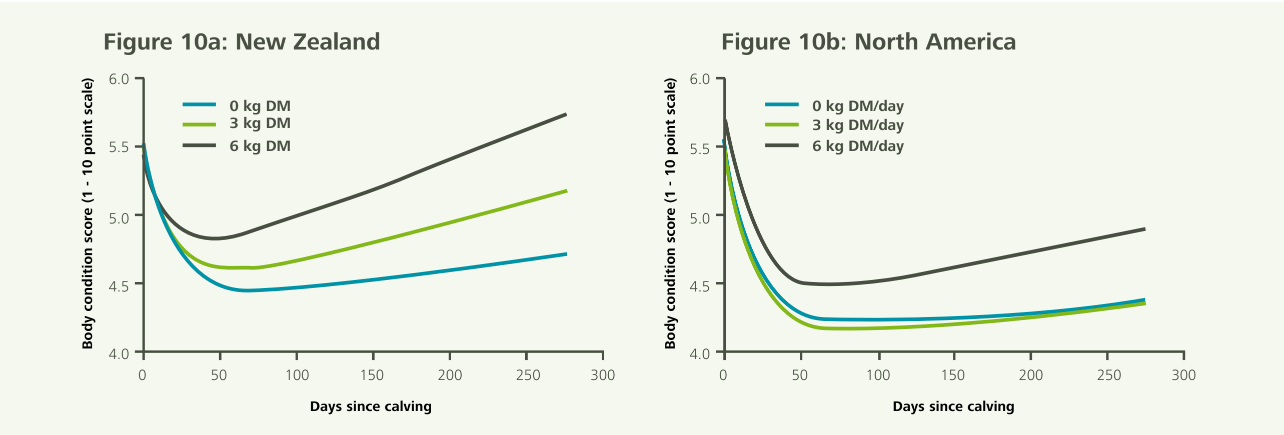
During the first 50 to 100 days after calving, BCS loss is largely regulated by genetics. There is very little that can be done from a management perspective to reduce the amount of BCS lost, particularly during the first month after calving.

An emphasis on genetic selection for milk production results in animals that partition more energy to milk production at the expense of BCS.

This has been highlighted in two studies.

- The New Zealand Strain Trial[16] compared New Zealand HF cows of 1970s genetic merit (NZ70), with New Zealand HF cows of 1990s genetic merit (NZ90), and HF cows originating from the USA and Europe in the 1990s (NA90). At dry off, NA90 were on average 0.4 BCS units thinner than NZ90 cows, and NZ90 cows were 0.3 BCS units thinner than NZ70 cows.
- A later study[17] compared higher producing cows of North American (NA) genetics with lower producing cows of New Zealand (NZ) genetics for the interaction between genetics and feed intake (Figure 10). The NA cows continued to lose BCS for longer after calving, reached a lower BCS nadir (the lowest point of BCS), and gained less BCS post-nadir compared to NZ cows, despite addition of supplementary feed.

Figure 10. BCS changes for cows with a) New Zealand and b) North American genetics fed well on pasture only or pasture plus 3 or 6 kg DM supplement/day17.



Preferential use of energy for milk production, rather than BCS, by different genetic types was highlighted in the same study.

NZ cows were able to regain condition during lactation when fed pasture only (Figure 10a) and showed a strong BCS response when fed 3 kg DM/day extra feed throughout lactation.

By comparison, NA cows struggled to regain condition after reaching their nadir (Figure 10b), requiring 6 kg DM/day throughout lactation to put on any significant condition during the rest of lactation.

Recognition of BCS in the BW equation

The BW equation recognises the important role of cow genetics for BCS. The equation penalises animals that naturally lose more than recommended body condition in early lactation and then have to regain it, as these are considered inefficient in a NZ system.

4. Nutrition

Body condition score loss during the first four to five weeks post-calving is not primarily influenced by nutrition.

- Cows restricted in intake for the first few weeks post-calving produced less milk, but their loss of BCS and Lwt were not affected[18, 19].
- Cows fed high-energy supplements in addition to pasture after calving lost BCS at the same rate as cows that did not receive supplement (Figure 10).

Nutrition can influence BCS at four to five weeks after calving.

- Cows fed high energy supplements in addition to pasture reached their BCS nadir earlier and gained more BCS after nadir than cows fed pasture alone (Figure 10).
- Genetics still plays a role, such that cows selected for high milk production preferentially partition nutrients to milk production and not to BCS gain, so continue to lose more BCS for a longer period in early lactation[17] (Figure 10).

Nutrition continues to influence BCS in mid and late lactation.

- The second trough in the "W" shape BCS profile curve (Figure 7) tends to occur in systems where pasture quality and quantity is limiting. Cows often enter a second period of negative energy balance, usually due to summer dry conditions.
- Cows fed very well on pasture and/or supplemented with concentrates during this period did not experience this second decline in BCS (Figure 10).

The lactating cow still preferentially partitions energy towards milk production.

- In the NZ Holstein-Friesian strain trial, Holstein-Friesian cows of NZ origin (NZ90) required 2 kg DM/cow/day maize grain-equivalent for a month (65 kg DM/cow) in addition to pasture, to gain 0.1 BCS units[16]. This is equivalent to 1 BCS unit from 650 kg DM maize grain.
- By comparison, Holstein-Friesian cows of North American origin (NA90) required 6.5 kg DM/cow/day maize grain supplement, in addition to pasture, to achieve a similar BCS gain[16]. Their response was equivalent to 1 BCS unit from 1,700 kg DM maize grain.

During the dry period, the type of feed offered affects BCS change.

- Energy in autumn pasture is used the least efficiently for gaining BCS. Energy from feeds like maize silage, pasture silage and palm kernel extract (PKE) are used 20, 20 and 40% more efficiently, respectively (see **page 39**).

5. Milking frequency

Reducing milking frequency to once a day (OAD) can help increase BCS during lactation. This is because reducing milking to once daily reduces the amount of milk produced, reduces energy demands for walking, and can increase grazing time, thereby providing more energy for condition gain.

In a multi-year farm systems trial[20], comparing Jerseys (J) and Holstein-Friesians (HF) that were milked OAD and twice a day (TAD) for whole lactations, cows milked OAD had higher BCS at eight weeks after calving (0.2 to 0.4 BCS units for J and HF, respectively) and at dry off (0.4 to 0.9 BCS units for J and HF respectively). But this was alongside annual milk production losses of 20% for J and 30% for HF.

Strategic use of OAD milking in early lactation can alter the energy status of cows after calving[21, 22]. A short period of OAD milking after calving led to OAD milked cows being slightly higher in BCS (0.15 to 0.23 BCS units for three and six weeks of OAD milking, respectively) than cows milked TAD, by six weeks after calving, and they remained higher through mating and mid lactation. Production losses were in the order of 15-20% during OAD milking, and remained lower when cows returned to TAD, leading to seven and 12% less total milksolids production by late lactation. When there is a feed shortage in early spring, OAD milking after calving can improve energy status of cows receiving less than their ideal ration, but milk production will be impacted[23].

Milking cows three times in two days (3in2) has less impact on milk production, with only a 5% reduction in full season production compared to TAD milking. Whole season farmlet studies of 3in2 milking found the energy saved from walking was sufficient for a 0.25 unit BCS gain over the whole lactation for cows milked 3in2 compared to TAD. Use on commercial farms has revealed lower production losses and greater BCS gains can be achieved. For more information, go to **dairynz.co.nz/milking-intervals.**

See **Section 3 - Strategies to achieve targets** for more information on how to use milking frequency in late lactation to improve BCS.

Summary

Remember that BCS targets at calving have been set to manage the balancing act between optimising dry matter intake, milk production & reproduction, and minimising health and welfare issues of being too fat, or too thin.

Achieving BCS targets at calving can have far reaching impacts for individual cows, and your herd.

Cows that are below target BCS at calving tend to:

- produce less milksolids during lactation,
- cycle later after calving,
- be more prone to milk fever, mastitis, uterine infections, and lameness, and
- are more likely to become pregnant with bull calves, at their next mating.

Cows that are above target BCS at calving tend to:

- eat less after calving,
- be more prone to milk fever, ketosis, and metabolic diseases after calving, and
- lose more condition after calving.

This in turn can affect:

- their ability to get in calf at mating time, and
- the lifetime production and reproductive success of their daughters.

The change in BCS of individual cows through lactation is affected by:

- Time since calving,
- BCS at calving,
- Genetic makeup of the cow,
- Type of feed and amount of feed, and
- Milking frequency.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Section 5
Appendices

Frequently Asked Questions

1. How accurate does BCS need to be? Why do we not score to the nearest 0.25 BCS unit?

For most people, visually scoring to a greater accuracy than 1.0 BCS units requires formal training. Even with training and experience, an assessor can only score cows to a 0.5 BCS unit visually with confidence. Very experienced assessors can score cows to 0.25 BCS units if they are able to feel the main body parts. This cannot be done accurately and consistently by sight. Remember 0.25 BCS units is only 6-8 kg Lwt. Herd average BCS can be reported to 0.1 BCS units.

2. How can I stop the BCS loss after calving?

Cows lose BCS naturally after calving. The fatter they are at calving, the more they lose. On average, a cow calving at BCS 5.0 will lose approximately 1.0 BCS unit after calving, while a cow calving at BCS 6.0 will lose approximately 1.5 BCS units and a cow calving at BCS 4.0 will lose 0.75 BCS units.

This post-calving loss is primarily regulated by genetics and, provided the cow is healthy, cannot be influenced by management or nutrition during the first five weeks after calving. At this point, supplements will slow the rate of BCS loss and increase the rate of BCS gain. However, the effect of feeding on BCS gain is small while the cow is milking because she has been selected to turn feed into milk and not into BCS.

3. How much feed is needed for BCS gain to get improved reproduction?

Hitting BCS targets at calving (5.0 for mixed age cows, and 5.5 for first- and second-calvers) supports reproductive performance. This will have better reproductive performance outcomes than any changes in feeding post-calving. Therefore, the amount of feed needed is relative to the requirements needed to reach those targets during the dry period.

- New Zealand research indicates that 125-200 kg DM of additional feed above maintenance requirements is required to achieve a 1.0 unit increase in BCS in dry cows (see **page 50**).
- Heifers (rising two-year-olds) should be BCS 5.5 at 22 months as it is difficult for heifers to gain weight while they adjust to the herd hierarchy post-calving.
- Second calvers are another high-risk group. Research suggests that cows in their first lactation do not gain as much BCS in late lactation as their mature herd mates and second calvers are often the lightest group at calving if not preferentially managed in the autumn.

4. Does milking cows OAD before mating help with BCS and getting cows in calf?

There is little information about OAD milking pre-mating in pasture-based dairy cows and the effect on reproductive outcomes. The theory is that by reducing the milking frequency, and therefore milk and energy output, you will be able to improve the energy balance of the cow, and therefore help her resume cycling earlier and be more fertile by the time mating starts. Anecdotally, some farmers who have used this approach have seen a positive shift in reproductive performance, however they have noted the following important factors.

- Minimum of three weeks on OAD before PSM – the longer the better.
- Continue with OAD after mating has started. If you stop again at the beginning of mating, the cow will undergo another period of stress that may impact her ability to conceive.
- Ensure that cows are still fed to twice-a-day levels – if you restrict the amount of feed when you change them to OAD you won't get the benefit of manipulating their energy balance.
- Cows only come to the farm dairy OAD – some farms will still bring cows in TAD, particularly if there is another herd milking, or to feed through the dairy. This will have an impact as their energy requirements are not being reduced.

The potential consequences for bulk milk SCC and milk production should also be considered when assessing this option.

5. If short of feed, what is the best option: increase BCS before calving or save feed for the milkers after calving?

The aim is to get more than 85% of cows to BCS 5.0 and all first and second calvers to BCS 5.5. The greatest return from extra feed will be from increasing the BCS of the lightest cows. Sort mobs and feed better conditioned cows at maintenance levels.

From six to eight weeks pre-calving, building average pasture cover needs to be a priority. Experiments at DairyNZ indicate a loss of about 0.25 BCS units and 4 kg milksolids/cow when cows were severely restricted (50% restriction) each day during the last month before calving. A similar restriction (in kg DM terms) for five weeks after calving cost more than 30 kg milksolids/cow but did not affect BCS. However, the cows restricted pre-calving calved at BCS 4.5.

Supplements can be purchased to ensure cows are well fed and are gaining BCS while also achieving pasture cover targets.

6. How does BCS affect profit?

Body condition score affects milk production, reproduction, and health, as well as other less tangible factors.

A conservative estimate of revenue from increasing cow BCS from 4.0 to 5.0 is $120 per cow (at $6.00/kg MS). Improved animal health, greater numbers of replacement heifers the following season, and improvements in the long-term sustainability of the system are not included in this figure.

In comparison, it is estimated that a 500 kg cow requires 125-160 kg of palm kernel extract or maize silage to gain a BCS unit while dry ($45 to $70 feed expense including wastage).

7. A cow is more efficient (needs less feed/BCS unit) when lactating than dry. Why do we need to dry-off to gain BCS?

Although there is evidence that lactating dairy cows require 20% less energy to gain a BCS unit than dry cows, genetic selection priorities over several decades have resulted in a cow that only reluctantly partitions energy to BCS gain in preference to milk production in mid and late lactation.

In addition, milking cows also require

- Between 10 and 20 percent more energy for maintenance than dry cows
- Approximately 2.0 MJ for every km walked on the flat (approximately 8 MJ/day if the average paddock is 1 km from the shed and the cow is milked twice a day).

These additional requirements negate much, if not all, of the difference in energetic efficiency for BCS gain. In addition, lactating cows partition only a small proportion of available nutrients towards BCS gain.

8. Are some feeds more efficient than others at BCS gain?

Yes, there is a difference in the efficiency with which feeds are used for BCS gain, with research results suggesting that fat (e.g. PKE) may be used more efficiently than starch (e.g. maize silage) for BCS gain in dry pregnant cows.

9. What are the consequences of calving cows at BCS 4.5?

Cows calving at BCS 4.5 will produce less milksolids (~$34 milk revenue at $6.00/kg MS) and cycle three to four days later than they would have, had they calved at BCS 5.0. In addition, cows that calve at BCS 4.5 are more likely to be less than BCS 4.0 at mating and, therefore, have lower submission and conception rates.

There will always be a percentage of the cows that are not at BCS 5.0 at calving. The target is to have greater than 85% of the mature cows at BCS 5.0.

10. How can I best use OAD milking in Autumn to achieve BCS targets?

OAD is a good management option for cows to gain BCS in late lactation providing:

- OAD milking starts in early summer, as the expected BCS gain in reasonably well-fed cows milked OAD is only 0.2 BCS units/month,
- the OAD milked cows are well fed, grazing to the same residuals as twice-a-day (TAD) milked cows. If you are using OAD as a strategy to reduce feed demand on-farm, this will result in minimal BCS gain, as the cows will put all energy into maintenance and milk production and have no surplus energy left to partition towards BCS gain, and
- the herd has a bulk milk SCC that ensures continued grade-free supply.

11. Is it true that regardless of how much the cows are fed, some cows will not gain weight and be BCS 4.0 at calving?

All cows will gain BCS providing they consume more energy than they require for maintenance and pregnancy. If feed is not sufficiently energy dense, or if the cow has health problems that reduce dry matter intake, BCS gain will be limited.

12. I heard that if cows gain BCS quickly in autumn they lose it quickly in spring - is this true?

No, this is not true! The reason for the confusion is because people fail to account for the genetics of the cow.

Cows that have to gain BCS quickly in autumn are generally the thinnest cows. These cows are most likely to be thin because they are genetically driven to produce milk and lose the most BCS in spring and do not gain BCS in mid-lactation. What is important is that cows get to BCS 5.0 and first and second calvers to 5.5 at calving. There are multiple ways to do this successfully. How fast cows gain BCS in autumn is not important.

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Section 3

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