Measuring carcase traits in lamb

What do you need to know?

Considerations for a progeny test

Why should I measure lambs for carcase traits?

You might be interested in making more genetic gain in carcase traits specifically to target markets where eating quality and yield will be important.
Alternatively, you may be looking to make balanced selection across a range of traits without negatively impacting eating quality and yield.
Carcase measurements can be taken on progeny of Merino, Dohne, Maternal and Terminal breeds to increase the size of the *reference population*. These measurements enable genomic prediction to become more accurate for related animals.

How do I measure carcase traits in lamb?

Carcase information is collected on farm, in the abattoir and laboratory.
Lambs are raised in one management group for most effective data. This means they will be similar age, ran under the same conditions and be finished at the same time.
Where possible lambs will be processed in one kill group at an abattoir with a target average carcase weight of around 23 to 25kg to ensure the highest proportion of lambs fit into an 18 to 32kg carcass weight grid. Measurements will be taken in the chillers on kill day such as carcase weight, GR fat depth, temperature and pH declines. Depending on where the animals are slaughtered, DEXA measurements of carcass yield may also be collected. The carcase or animal is sold to the abattoir by the producer.

Sheep Genetics will arrange for a meat science laboratory to coordinate the processing and measurements. These meat science teams are best positioned to liaise with meat processing companies on your behalf. This is important for maintaining functional relationships with meat processors. Please do not burden meat processors with requests by directly contacting them. Upon request, it is possible for producers to join the meat science team on kill day and bone-out day to assist with the processing of the lambs as a technician. All necessary training will be provided by the meat science team.

The loins are purchased from the abattoir by the meat science team and taken to a laboratory for further measurements. This is where lean meat yield is measured by weighing bone, loin fat and lean (meat), as well as measuring C site fat depth, and eye muscle depth (EMD) and width. The loins are prepared for chemical *intramuscular fat* (IMF) and *shear force* (SF5) analysis. Images of the loins can also be taken on request for the producers.

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Some on farm traits also provide good information about carcase attributes. Ultrasound scanning for fat and muscle depth provides a good indicator of muscle and fat in carcases. Post weaning weight is also highly related to carcase weight. We take account of these relationships between traits, called *genetic correlations*, in the Australian Sheep Breeding Values (ASBVs). Measuring on farm traits as well as carcase measurements will provide better data.

Carcase traits are expensive to measure so it is important to plan the progeny test to get the most value from the investment. The cost per lamb for carcass testing is around $120 to $200 per carcase and is charged at cost for labour, travel, loin purchases, processing and measurement costs. This is offered at a service to industry to improve rates of genetic gain and better meat quality data in Sheep Genetics.

How is the information used?

The carcase data is combined with genotypes, pedigrees and on farm performance to provide the results as ASBVs. The progeny test lambs will have their data included in the relevant Sheep Genetics analysis (e.g. Terminal LAMBPLAN).

This increases the accuracy of carcase traits for related animals, especially the sire. The data also contributes to the reference population.

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What breeds can genotype?

For your breed to effectively genotype for a trait (to get ASBVs), the following needs to be met:

- Large enough reference population
- Diverse representation of animals in the reference population
- Current animals must be related to the reference population
- Technical capacity in Sheep Genetics evaluations.

Currently there are four breeds that meet all of those criteria. These breeds will benefit from genotyping:

- Border Leicester
- Merino
- Poll Dorset
- White Suffolk.

These breeds can submit genotypes and have them included in their respective analysis but will not see much benefit yet*:

- Composite Maternal
- Coopworth
- Corriedale
- Dorper and White Dorper
- Hampshire Downs
- Southdown
- Suffolk
- Texel.

If you are interested in genotyping any other breed then contact Sheep Genetics.

**These breeds may not see the desired increase in accuracy nor changes with genomically enhanced ASBVS because the reference populations is small or not diverse enough. Genotypes will still be included in the analysis. The best approach for these breeds is to have more animals measured for the traits of interest and genotyped.*

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What carcase traits are measured on my lambs?

Measurement	Details	What ASBV does it help?
Live weight	Pre-slaughter live weight before going to abattoir with an overnight fast	**DRESS%**
Carcase weight	Hot standard carcase weight.	**CWT** **Highly correlated to growth. Used to standardise other measures.**
Carcase fat depth	GR Fat depth taken at the 12th rib using a special knife. C-site fat depth	**GRFAT and CFAT (related to PFAT)**
Carcase eye muscle depth and width	Eye muscle depth and width between the 12th and 13th ribs.	**CEMD and CEMW**
Number of ribs	The number of ribs in lambs is usually 13 but sometimes there are 12 or 14.	**We are building a database to see if it's related to anything else.**
pH and temperature decline	Post slaughter, the pH of meat declines. The rate at which this happens and the temperature affects the quality of meat, especially toughness.	**Used to detect whether there was cold shortening. Helps with shear force (SF5) data.**
Bone-out weights	Fat, muscle and bone are separated and weighed as a proportion of the whole primal	**LMY**
Intramuscular fat	A portion of trimmed lean is minced. A chemical extraction determines the amount of fat stored within the muscles. This is intramuscular fat or *marbling*	**IMF**
Shear force	A portion of trimmed lean is prepared and aged for five days. A machine measures the force required to cut through the sample. This indicates the toughness of the meat.	**SF5**
Additional traits	Where possible additional traits may be measured for research and development purposes.	
Consumer tasting	Optional add on.	**Used in MSA and research.**

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What type of sheep are suitable?

Select appropriate sheep for measuring carcase traits. The sheep need to have enough information to be useful in Sheep Genetics analyses. Here are some considerations:

Management groups

In Sheep Genetics analyses, we can only compare the performance of lambs that have been raised in the same environment.
Keep lambs within one big *management group* as much as possible to get an effective progeny number.
When you send in data to Sheep Genetics, we take the management group you provide and add some other important filters. Here is how we form *contemporary groups*:

Design the progeny test to minimise splitting at each section to get larger contemporary groups.

Fixed effects

These are factors which effect progeny performance but are not genetic. In Sheep Genetics you can take account of:

- Birth type
- Rear type
- Age of dam
- Date of birth

There are alternative ways to collecting this information. Pregnancy scanning can be used to determine birth type. If you use artificial insemination to mate the ewes, the lambs will be born within 10 days so date of birth can be assumed to be the middle date without much effect on ASBVs. Although if lambing occurs over a longer period, it is highly recommended to record individual dates of birth.

It's always best to check your plans with the team at Sheep Genetics first.

Effective progeny numbers

There needs to be enough lambs in a group to provide useful data for genetic evaluation. Each sire must also have enough progeny in a group to have effective progeny numbers.

We recommend at least 8 animals (of one sex) in contemporary group as shown in figure 1.
Having more sires in a contemporary group also increases the effectiveness of the records because more genetics are being compared in the same environment as seen in figure 2.

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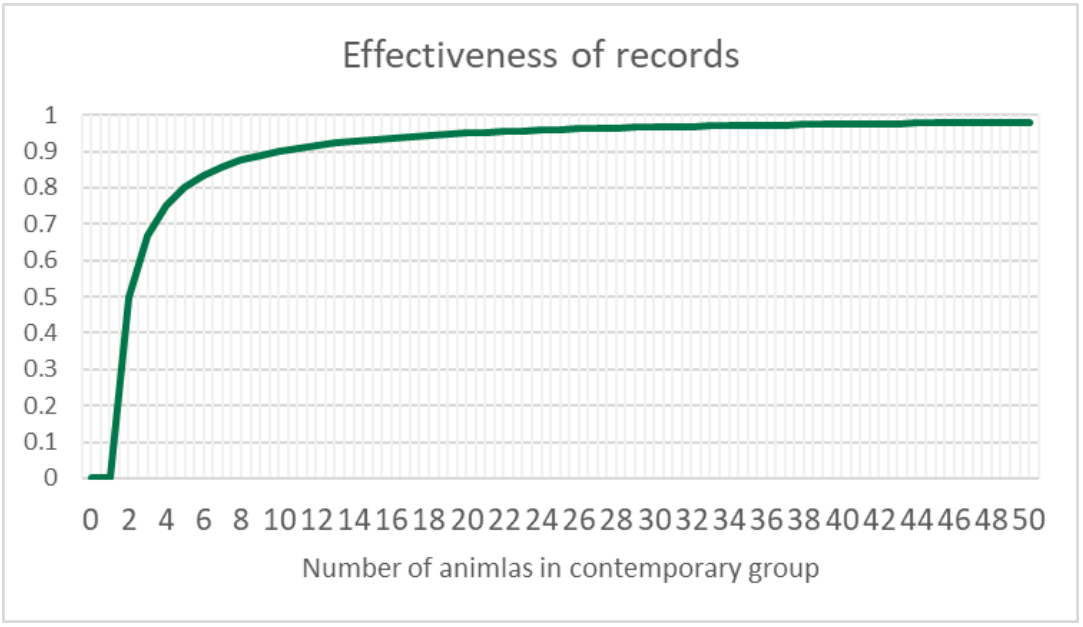

Figure 1: Proportion of effective records for a given number of animals in the contemporary group

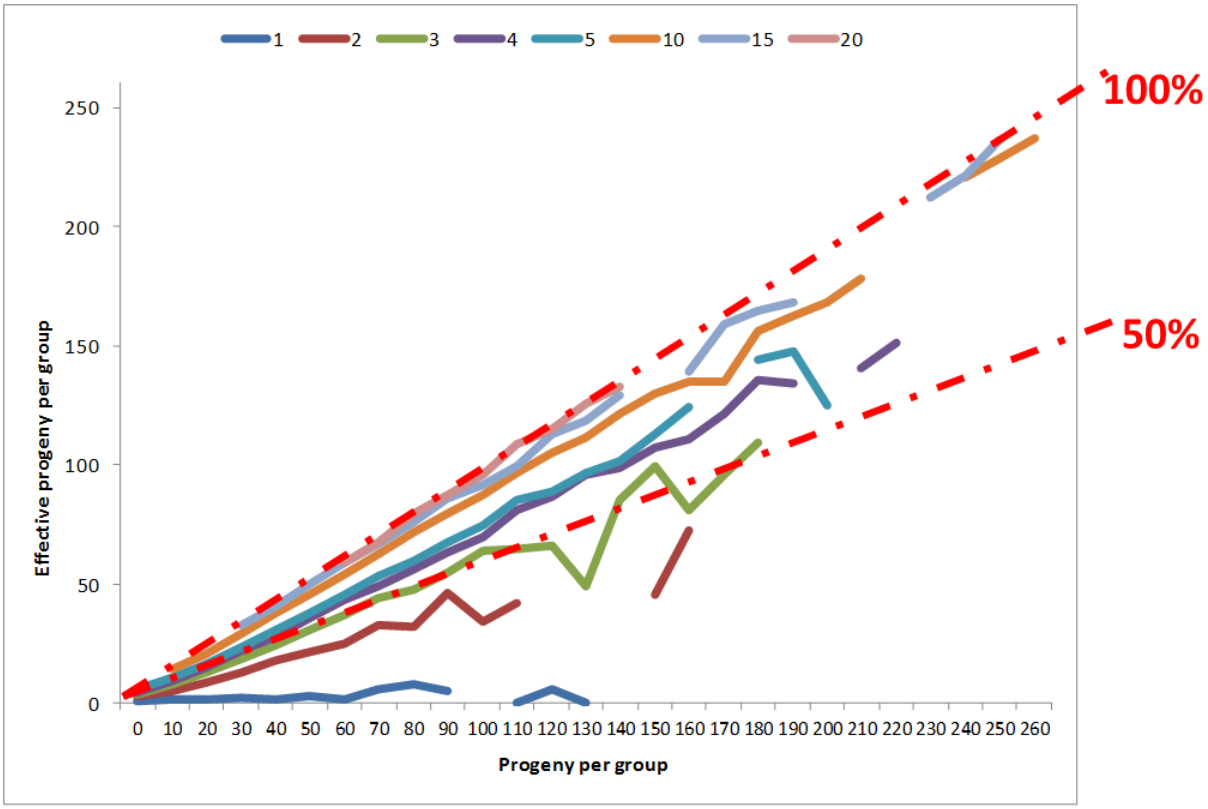

Figure 2: More sires represented in a contemporary group increases the effectiveness of records. Having three sires per contemporary group gives 50% of potential effectiveness. (Note this example is based on real performance data in Sheep Genetics.)

It is advised to run a dedicated progeny test mob and not try to utilise surplus stud animals.

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Mob size

There are recommended minimums on the number of lambs processed on one day. We recommend mob size should be over 100 head for logistic efficiency. There is a maximum capacity as well depending on the meat science team of around 300 head – 250 per kill group is the ideal number. If numbers exceed 250 head, then maybe 2 management groups could be managed as they will most likely be killed in 2 groups.

What sires should be used?

Carcase traits are usually measured on a group of progeny test lambs. Progeny test lambs are not intended to be part of the main breeding flock.

You will get the most benefit from including rams that will have their genes in the future population. To do this look for rams that are current and high merit. These might be sires that are widely used or emerging young rams that show good potential. The reason for this is that genotyping works best if the genotyped animal is closely related to the reference population.

Also consider measuring progeny of rams from a range of 'bloodlines' or flocks so that genotyping works better across the whole breed.

At least one sire should provide *linkage* to the rest of the analysis. Link rams are rams with progeny already recorded with Sheep Genetics in another flock like the resource flock. You can get stronger linkage for carcase traits by using a sire in your progeny test that already has lambs measured for carcase traits e.g. a sire in resource flock. Using one link sire per 10 sires sampled is a good idea as a rough guide.

TIP: Search for rams with progeny measured for carcase traits by ticking the *progeny in reference flock* on the Sheep Genetics search website.

Which dams should we use to produce the lambs?

This depends on how you are designing the progeny test. Dams can be fully recorded ewes with Sheep Genetics or anonymous commercial ewes. The way you run the progeny test is different for both.

Ewes already recorded with Sheep Genetics.

If you decide to go down this path, it is important to record dam pedigree.

Commercial ewes not in Sheep Genetics.

Using commercial ewes might be more practical in some situations. Some people like the idea because it reflects commercial production systems but it does not make any difference to the ASBVs.

Commercial ewes are more readily available.

Try to randomly mate as best as possible to avoid mating bias. Where ewes are across age classes, be sure to allocate evenly across ages to each sire.

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What do you do in a progeny test for carcase traits?

Event	What to consider	Alternatives
Mating		
Select sires for the progeny test	Are sires are relevant to current and future population? Is at least one link sire included?	
Joining	Joining method determined. Ewes allocated to rams evenly. Will there be enough lambs per sire?	
Genotype sires	Take DNA samples of rams at joining or AI.	
Lambing		
Birth	What fixed effects will you record? Will you measure birthweight (optional)? Do you need to record dam pedigree?	If lambs are born within 10 days, birth date can be the middle date.
Identifying lambs	Have you got two tags in each lamb?	
Genotype lambs	Take DNA samples at marking (tailing).	Take DNA at weaning
Weaning and Post weaning		
Weaning weight	Weigh every lamb at weaning. Wean all lambs on the same day.	
Fat and muscle scanning	Are the lambs heavy enough (>30kg) and fat enough (>2.5mm min) to scan? Scan all lambs on the same day.	
Optional extras	Are there other traits you would like to record to build the reference for?	
Slaughter		
Weight prior to slaughter	Even curfew for all lambs.	
Lambs are heavy enough	Lambs should be 18-26kg carcase weight.	

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Definitions

Contemporary group	The grouping used in the Sheep Genetics analyses. It is a group of sheep that are from the same site, year drop, sex, management group, date of measure and age.
Genetic correlations	The relationship between traits that is due to genetic effects.
Linkage	Having a genetic connection to other flocks that record the traits of interest. Linkage can be obtained by using a sire that has progeny measured in another flock.
Intramuscular fat	The fat stored within the muscle. Also called marbling in beef. It is associated with increasing overall consumer liking particularly the juiciness of lamb. It is measured in the laboratory by chemical analysis. The amount of intramuscular fat is expressed as a percentage of the meat sample.
Management group	The grouping that is defined by the breeder in their recording software. It allows sheep to be only compared against animals that were ran in the same conditions.
Reference population	Animals within a breed that have been measured for the traits of interest and have been genotyped. The reference population is used to inform genomic ASBVs.
Shear force	The amount of force require to cut through a piece of meat. Reducing shear force is associated with increasing overall consumer liking particularly the tenderness of lamb. It is measured in the laboratory. Shear force is expressed as a kilograms or Newtons.

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