Sheep GENETICS

MEAT & LIVESTOCK AUSTRALIA

# Maternal indexes

## A ram breeder's guide

### Why use a selection index?

A selection index is an important tool to drive genetic improvement in ram breeding programs when there are a range of traits of economic or functional importance. Collectively, these traits make up the "breeding objective", which aims to improve profitability in commercial sheep enterprises.

Indexes are useful for two main reasons:

1. They balance genetic improvement appropriately across a range of traits, with the emphasis placed on each individual trait determined by its relative importance.
2. Because indexes balance improvement across traits, they can be used to overcome economically antagonistic relationships *between* traits.

> Appropriately designed indexes are central to the goal of breeding more profitable sheep for your ram buying clients.

### How Sheep Genetics develops selection indexes

When Sheep Genetics develops standard selection indexes, a breeding objective is defined for each breeding scenario. This involves an analysis of commercial flock production data to calculate the economic value of improving traits which affect profit, based on flock structure, production and price data.

The second step is to translate the breeding objective into the index by linking profit traits to ASBV traits through genetic correlations. Often the profit and ASBV traits are the same, for example early growth rates (weaning and post-weaning weights) are key profit drivers in commercial maternal flocks and are also easy to measure in ram breeding flocks. For profit traits which are hard to measure however, we may rely on correlated traits to drive improvement in the objective. An example of this is ultrasound scan measurements of muscle and fat to improve carcase yield. More recently, genomic information has become increasingly important for genetic improvement of these hard to measure traits.

By combining the economic values of traits with the genetic relationships between traits we can determine the appropriate relative weightings which allow us to combine ASBVs into a single index value for each animal.

> The changes in individual traits from using an index depend on the information you record in your flock. If you want to improve, or even just maintain a trait, you must record it to ensure ASBVs are sufficiently accurate for the index to do its job.

### LAMBPLAN Maternal indexes

LAMBPLAN has four standard indexes for maternal sire breeders:

- Border Leicester Cross (BLX)
- Maternal Carcase Production (MCP)
- Maternal Carcase Production Plus (MCP+)
- Maternal Wool Production Plus (MWP+).

These indexes target improved performance of maternal sires in a range of maternal production enterprises.

The BLX, MCP and MCP+ indexes all address the need to limit increasing mature size (adult weight ASBVs) in maternal ewes while balancing this with selection of other key profit traits.

It is important to choose an index that is most relevant to your breed and the objectives of your ram buyer clients, including future lamb markets to be targeted.

## Border Leicester Cross (BLX)

### Summary of the BLX index

- The BLX index targets improvement of a system where Border Leicester rams are joined to Merino dams to produce first cross progeny, with females used as ewes joined to terminal sire rams.
- BLX balances maintaining mature size with significant improvements in early growth and reproduction.
- Measuring adult weight in ewes makes BLX more effective at simultaneously maintaining mature size and improving key profit traits.

### Production system outline

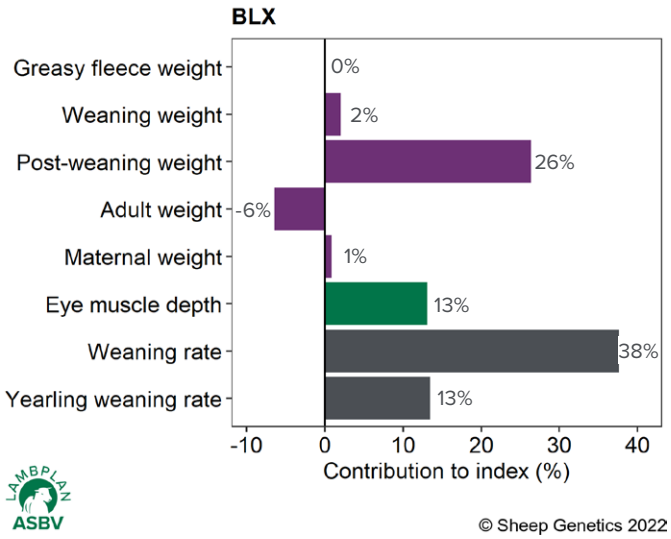
This production system is for a first cross operation where maternal sires are joined to Merino dams, with the first cross female offspring then used in prime lamb systems joined to terminal sire rams. The BLX index focuses on increasing growth, carcase eye muscle depth and number of lambs weaned. A small amount of emphasis on increasing fleece weight is also included.

### Trait contributions

Figure 1 illustrates which traits are in the index and how much they contribute to the overall balance of the index in the top 10% of current Border Leicester progeny. The longer the bar, the greater the impact on the index, and the greater impact on the profitability of the production system.

In the BLX production system, growth and reproduction contribute most to the index, with smaller contributions from carcase eye muscle depth and maternal weaning weight.

**Figure 1: The traits in the BLX index and how they contribute to the overall balance of the index in the top 10% of current Border Leicester progeny**




Adult weight makes a negative contribution to the index. This requires careful consideration: the negative contribution is a reflection that adult weight is higher than average in the top indexing animals represented in figure 1, which is contrary to the breeding objective of maintaining mature size. In the breeding objective, higher mature size is undesirable because bigger ewes have higher feed costs and are increasingly associated with animal handling and welfare issues. However, bigger ewes also produce more lambs, which reach sale weight faster, so the index makes a trade-off to achieve an optimal balance across all traits. The best way ram breeders can address this issue is by recording more adult weight data in breeding ewes: with more direct information contributing to ASBVs, more control can be placed on the trait.

### Selection advantage

Table 1 shows the selection advantage for the top 10% of the current Border Leicester progeny drop selected on the BLX index. The numbers show how much better the ASBVs of the top 10% are compared to the average of the drop. For example, ASBVs for post-weaning weight for the top 10% of progeny on BLX are 2.8kg higher than the average of the drop.

There are strong selection advantages for early growth rate (weaning and post-weaning weight), eye muscle depth, and weaning rate. As discussed above, the positive response for adult weight has a negative effect on the index because the breeding objective is to maintain mature size. Although post-weaning fat is not directly in the index, it is of interest because it provides useful information to improve the accuracy of ASBVs of index traits.

**Table 1: The selection advantage for the top 10% of the current Border Leicester progeny drop selected on the BLX index**

| | BLX |
|---|---|
| Greasy fleece weight (%) | 0.2 |
| Weaning weight (kg) | 1.4 |
| Post-weaning weight (kg) | 2.8 |
| Adult weight (kg) | 1.1 |
| Maternal weaning weight (kg) | 0.1 |
| Post-weaning eye muscle (mm) | 0.9 |
| Post-weaning fat depth (mm) | 0.6† |
| Weaning rate (lambs) | 0.13 |
| Yearling Weaning rate (lambs) | 0.23 |

† Trait not in index

When selecting on the BLX index, long-term responses in individual traits will vary depending on features of the breeding program including traits measured, level of pedigree recording, use of genomic testing, flock structure and selection emphasis on the index. The selection advantages shown in table 1 gives an indication of the likely direction and relativity of responses for the BLX index.

## Maternal Carcase Production (MCP and MCP+)

### Summary of the Maternal Carcase Production indexes

- The MCP index targets improvement of maternal sire performance in a self-replacing system with a carcase production focus.
- The MCP index focuses on growth, carcase, and reproduction traits, while aiming to maintain mature size.
- The MCP+ index includes the same traits as MCP with the addition of fleece weight and worm egg count.

### Production system overview

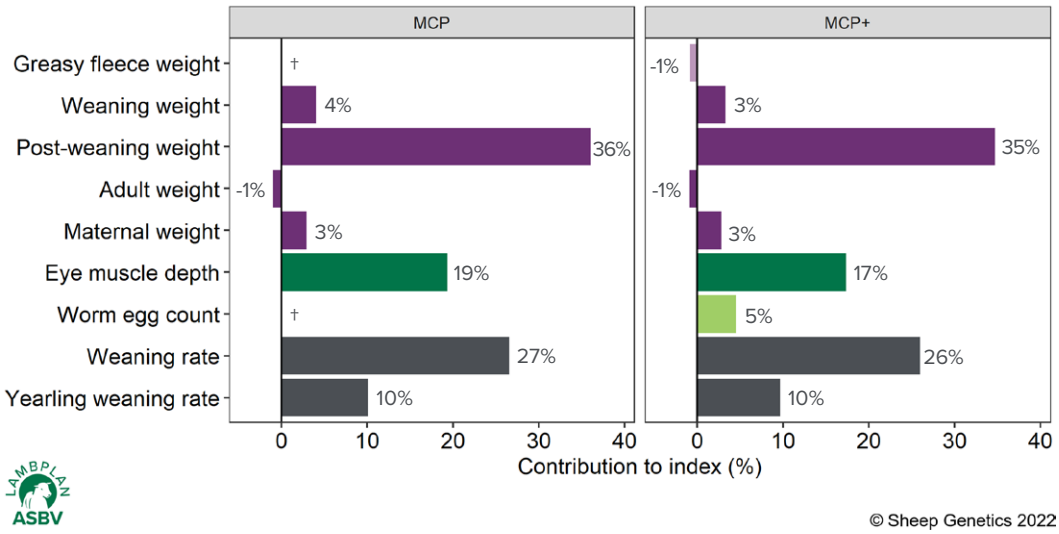
This production system is for a self-replacing system where maternal sires are used and there is a strong focus on carcase production. The MCP and MCP + indexes aim to maintain mature size at current levels. The MCP+ index adds fleece weight and includes a small amount of emphasis on improving worm egg count, which is of significance in high rainfall and/or high input management systems where internal parasites may cause significant economic losses

### Trait contribution

Figure 2 illustrates which traits are in the indexes and how much they contribute to the overall balance of the indexes in the top 10% of current maternal breed and composite progeny. The longer the bar, the greater the impact on the index, and the greater impact on the profitability of the production system.

In both MCP and MCP+, early growth contributes most to the indexes, with significant contributions from eye muscle depth and reproduction. The main difference between MCP and MCP+ is the increased contribution from worm egg count in MCP+ and the inclusion of fleece weight.

**Figure 2: The traits in the MCP and MCP+ indexes and how they contribute to the overall balance of the indexes in the top 10% of current maternal breed and composite progeny**




Adult weight makes a negative contribution to both MCP and MCP+ which requires careful consideration: the negative contribution is a reflection that adult weight is higher than average in the top indexing animals represented in figure 2, which is contrary to the breeding objective of maintaining mature size. In the breeding objective, higher mature size is undesirable because bigger ewes have higher feed costs and are increasingly associated with animal handling and welfare issues. However, bigger ewes also produce more lambs, which reach sale weight faster, so the index makes a trade-off to achieve an optimal balance across all traits. The best way ram breeders can address this issue is by recording more adult weight data in breeding ewes: with more direct information contributing to ASBVs more control can be placed on the trait.

### Selection advantage

Table 2 shows the selection advantage for the top 10% of the current maternal breed and composite progeny drop selected on both the MCP or MCP+ indexes. The numbers show how much better the ASBVs of the top 10% are compared to the average of the drop. For example, ASBVs for post-weaning weight for the top 10% of progeny for MCP are 2.3kg higher than the average of the drop.

There are strong selection advantages for early growth rate (weaning and post-weaning weight), eye muscle depth, worm egg count and weaning rate. Although post-weaning fat is not directly in the index it is of interest because it provides useful information to improve the accuracy of ASBVs of index traits.

**Table 2: The selection advantage for the top 10% of the current maternal breed and composite progeny drop selected on the MCP and MCP+ indexes**

| | MCP | MCP+ |
|---|---|---|
| Greasy fleece weight (%) | -2.2† | -1.5 |
| Weaning weight (kg) | 1.2 | 1.2 |
| Post-weaning weight (kg) | 2.3 | 2.2 |
| Adult weight (kg) | 0.1 | 0 |
| Maternal weaning weight (kg) | 0.3 | 0.3 |
| Post-weaning eye muscle (mm) | 0.8 | 0.8 |
| Post-weaning fat depth (mm) | 0.2† | 0.2† |
| Worm egg count (%) | -18.7† | -22 |
| Weaning rate (lambs) | 0.1 | 0.1 |
| Yearling weaning rate (lambs) | 0.19 | 0.19 |
| † Trait not in index | | |

When selecting on MCP or MCP+, long-term responses in individual traits will vary depending on features of the breeding program, including traits measured, level of pedigree recording, use of genomic testing, flock structure and selection emphasis on the index. The selection advantages shown in table 2 give an indication of the likely direction and relativity of responses for the MCP and MCP+ indexes in maternal breeds and composites.

## Maternal Wool Production Plus (MWP+)

### Summary of the MWP+ index

- The MWP+ index targets improvement of a self-replacing maternal system where improvements in wool production and quality are important.
- MWP+ balances improvements in wool production and quality with increases in growth, carcase and reproduction, and includes emphasis on worm egg count.

### Production system outline

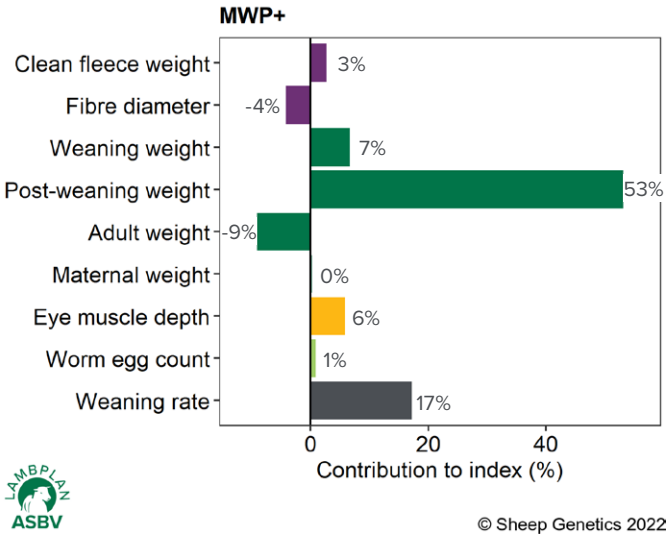
This production system for a self-replacing maternal system where increasing wool production and quality are balanced with improved growth, carcase and reproduction. This index would be suitable for a maternal production system where wool is an important income source, for example in SAMM and Corriedale flocks. The index also includes emphasis to reduce worm egg count.

### Trait contribution

Figure 3 illustrates which traits are in the index and how much they contribute to the overall balance of the index in the top 10% of current Corriedale sires. The longer the bar the greater the impact on the index, and the greater impact on the profitability of the production system outlined above.

Growth and reproduction contribute the most to index, with a moderate level of emphasis on eye muscle depth. For wool traits, quality and production are balanced between fibre diameter and fleece weight. Adult weight also makes a negative contribution to the index when considered on its own because bigger ewes have higher feed costs. However, bigger ewes also produce more lambs which reach sale weight faster, so the index makes a trade-off to achieve an optimal balance across all traits.

**Figure 3: The traits in the MWP+ index and how they contribute to the overall balance of the index in the top 10% of current Corriedale sires**




### Selection advantage

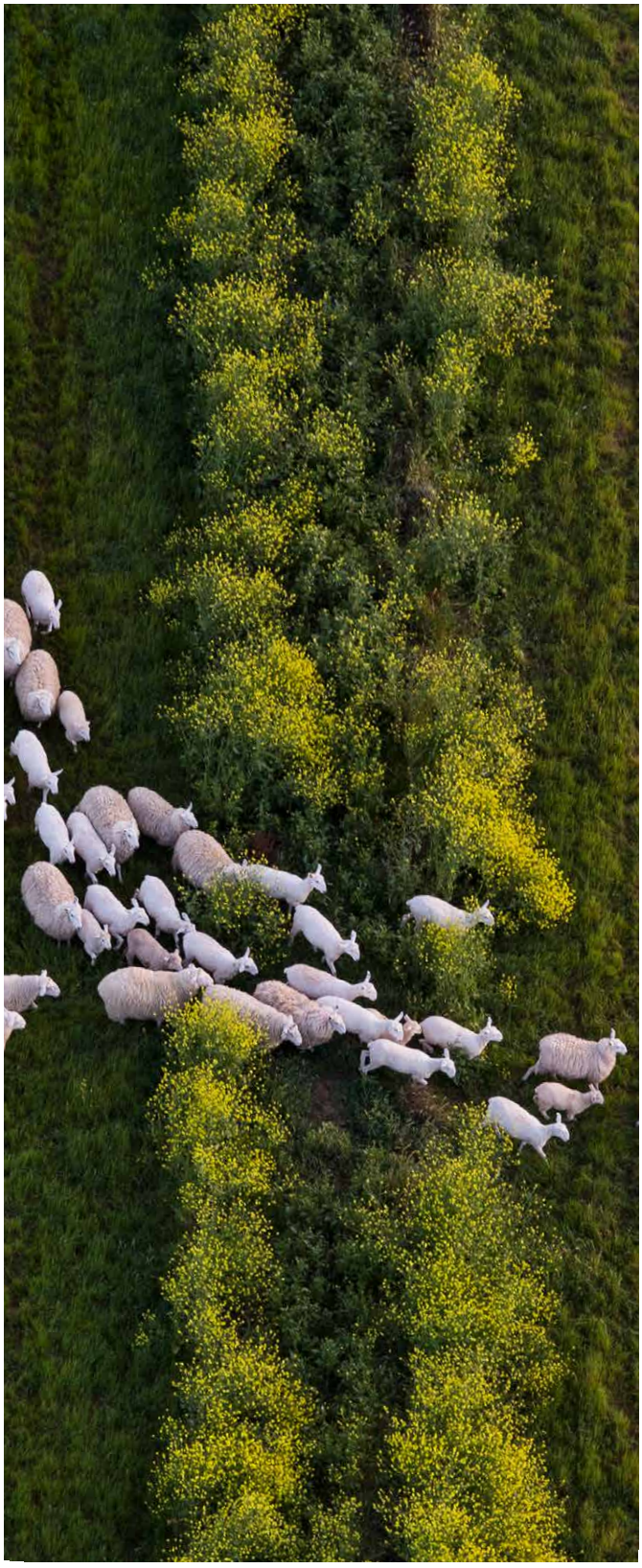
Table 3 shows the selection advantage for the top 10% of the current Corriedale sires selected on the MWP+ index. The numbers show how much better the average ASBVs of the top 10% are compared to the average of the group. For example, ASBVs for post-weaning weight for the top 10% of sires on MWP+ are 3.2kg higher than the average of the group.

There are strong selection advantages for early growth rate (weaning and post-weaning weight), eye muscle depth and weaning rate. The responses in fleece weight are favourable. As discussed above, the positive response for adult weight has a negative effect on the index because the breeding objective is to limit increases in mature size. While worm egg count in the MWP+ index is in the desired (negative) direction, the selection advantage is small. In flocks with a strong focus on this trait, there are larger selection advantages. Although post-weaning fat is not directly in the index, it is of interest because it provides useful information to improve the accuracy of ASBVs of index traits.

**Table 3: The selection advantage for the top 10% of the current Corriedale sires selected on the MWP+ index**

| | MWP+ |
|---|---|
| Clean fleece weight (%) | 2 |
| Fibre diameter (µm) | 0.3 |
| Weaning weight (kg) | 1.9 |
| Post-weaning weight (kg) | 3.2 |
| Adult weight (kg) | 3.8 |
| Maternal weaning weight (kg) | 0 |
| Post-weaning eye muscle (mm) | 0.4 |
| Post-weaning fat depth (mm) | 0† |
| Worm egg count (%) | -3.8 |
| Weaning rate (%) | 0.07 |
| † Trait not in index | |

When selecting on MWP+, long-term responses in individual traits will vary depending on features of the breeding program including traits measured, level of pedigree recording, use of genomic testing, flock structure and selection emphasis on the index. The selection advantages shown in table 3 give an indication of the likely direction and relativity of responses for the MWP+ index in maternal breeds and composites.



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