Across-flock connectedness – the principles

SIL Technical Note

Relates to: Value of genetic connections between flocks and what connectedness is
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Summary

- Genetic links between flocks are required to be able to validly compare genetic merit of animals in different flocks – this is termed "connectedness"
- Good connectedness is achieved through the sharing of rams (link sires) within years
- SIL recommends ram sharing on a regular, ongoing basis for across-flock evaluations
- SIL requires a link sire have a minimum of 20 progeny with performance measurements, within each flock, to contribute to across-flock connectedness calculations
- SIL recommends a minimum of 25-30 progeny with performance measurements in each flock, for each link sire
- SIL can assess the adequacy of connectedness between flocks

Background

What is connectedness? – It is the result of use of common genetic lines by different flocks – typically through use of common sires. As a result, there are lines of animals within different flocks, sharing common ancestry. If we collect performance measurements on animals in these flocks, we can use the connectedness to compare genetic merit of animals in the different flocks.

Why is it important? – Connectedness between flocks is required to enable us to make fair genetic comparisons of animals born in different flocks and run under different conditions.

Making fair comparisons

It is often very useful to be able to rate animals in different flocks against each other for genetic merit. For example, let's look at two homebred rams from two different flocks on the basis of weaning weights in their progeny (Table 1).

Smith's farm		Brown's farm	
Ram A	24kg	Ram B	27kg

Is the difference genetic or due to differences between the farms in management or feeding? We can't tell based on this information! However if both farms have used a common sire, and we have pedigree and performance data for their progeny, we can separate these effects.

Smith's farm		Brown's farm	
Ram A	24kg	Ram B	27kg
Sire C	25kg	Sire C	26kg

We can tell from this information that in the Smith flock, genes contributed by Sire C were better than genes contributed by Sire A by 1kg weaning weight, whereas in the Brown flock progeny of the homebred sire, Ram B, outperformed those of link sire C. Thus Sire B is superior to sire C and both are superior to Sire A.

Strong connectedness between flocks requires reasonable numbers of progeny for the link sires in all flocks AND for these progeny to have performance measurements collected for all traits that will be compared.

Valid comparisons can ONLY be made when we have strong genetic connections between flocks. These must be based on use of common sires in recent years, with performance data collected on reasonable numbers of progeny.

Definitions of connectedness

Direct connectedness – this occurs when two flocks both use a common sire. It is best when the sire is used in the same year. Using common sires in different years is not as good because it can be difficult to separate year effects from sire effects.

Indirect connectedness – this is when a number of flocks use common sires, but each flock does not share a sire with every other flock. Some flocks become connected indirectly. For example, Flock A shares a sire with Flock B, and Flock B shares another sire with Flock C. Flock A and Flock C are indirectly connected since they are both directly connected to Flock B.

Apparent connectedness – this is when one flock buys a young ram from another to use as a sire, but the ram has no progeny in his birth flock. So "connectedness" is based on the progeny of this ram in the flock wherehe was used as a sire relative to the progeny of his sire in his birth flock (he himself is one of his sire's progeny).

A problem occurs because genetic merit in one flock is based on genes passed to progeny – this is good because it shows what he is passing on. However, his genetic merit in the other flock is predicted from his own performance and that of his half-siblings (and other relatives). He may be better or worse, genetically, than this latter prediction for two reasons. Firstly there may be unknown, non-genetic effects that influenced his performance (e.g. his mother had mastitis this year). Secondly, he may have got a better (or worse!) than average set of genes from his sire so information from his half-siblings may under- (or over-) estimate his merit. Connectedness is best estimated from sires with progeny in two flocks, in the same year.

Importance of timing – we can get good connectedness between progeny groups that are many years apart. For example, a long-dead AI sire can be used in a flock based on semen stores which would connect two flocks, but quite some time apart. For example, Flock K used the sire in 1995 while Flock L used him in 2002. This means we have good connectedness between the 1995 born progeny in Flock K with the 2002 born progeny in Flock L. However, if we want to compare animals born in the two flocks in 2002 the connectedness between the flocks is weakened by the long period between 1995 and 2002.

For this reason, SIL calculates connectedness between flocks only from performance data from recent years. The aim is to use the last 3 years of performance data. Thus **recent** data is used to quantify connectedness between flocks since the most important comparisons to make are of sires used in recent years and of young, potential replacement animals.

How to set up and maintain connectedness between flocks

SIL recommends that link sires be used regularly, and that link sire progeny be kept for collection of performance measurements. The following points should be noted:

- Use common sires regularly, usually each year. Where possible, two link sires are better than one

- Once a flock has good connectedness, it may be possible to use fewer link sires
- It is critical that link sires are accurately identified. No connectedness can be identified when the same sire is given a different ID in different flocks
- SIL requires a link sire have a minimum of 20 progeny with performance measurements, within each flock, to contribute to across-flock connectedness. This minimum is to ensure that sire merit is accurately assessed within each flock.
- Typically, aim to get 25-30 progeny per sire with performance measurements in each flock. Consider lambing percentage and lamb survival (including culling) to various ages when deciding on how many ewes to put to link sires
- Where animals are destined to be culled for traits that do not affect performance (e.g. black spot in wool), they should be kept until all measurements are collected
- Where maternal traits are critical (e.g. number of lambs born, mothering ability) more progeny born to each sire are needed since only females supply performance data and there can be heavy culling before they enter the ewe flock

Finding out how well connected flocks are

SIL can quantify the degree to which flocks in a group are genetically connected for key economic traits (Growth, Meat, Wool, Reproduction and disease traits).

Quantifying connectedness identifies those flocks between which valid comparisons can be made. It also identifies those flocks, or subsets of flocks, that need to actively pursue a policy of strengthening connectedness with the main group.

Connectedness is depicted as a "linkage tree" (see following graphs). The scale along the bottom is a measure of genetic distance between flocks, where zero is very highly connected, and 0.5 is not connected at all. There is a zone in the middle where connectedness is adequate but needs attention. Critical thresholds are summarized in Table 3. Thresholds are lower for Reproduction because it is less heritable. This means more progeny performance records are needed for the same level of connectedness.

Connectedness calculations are conducted on the last 3 years of data. For reproduction this requires going back further since the last 1-2 years may have no daughter lambing records for link sires. Connectedness is not assessed for Survival.

Table 3. Critical Connectedness Thresholds	Connectedness		
Traits	Strong	Adequate but needs attention	Weak
Growth, Meat, Wool & WormFEC	0 - 0.24	0.24 -0.30	above 0.30
Reproduction	0 – 0.15	0.15-0.19	above 0.19

How well connected flocks are depends on whether the line connecting them on the graph crosses these critical thresholds. Examples are shown in graphs on the following pages.

Connectedness is characterised for traits. It is not a characteristic of an index since some traits may show adequate connectedness while others do not.

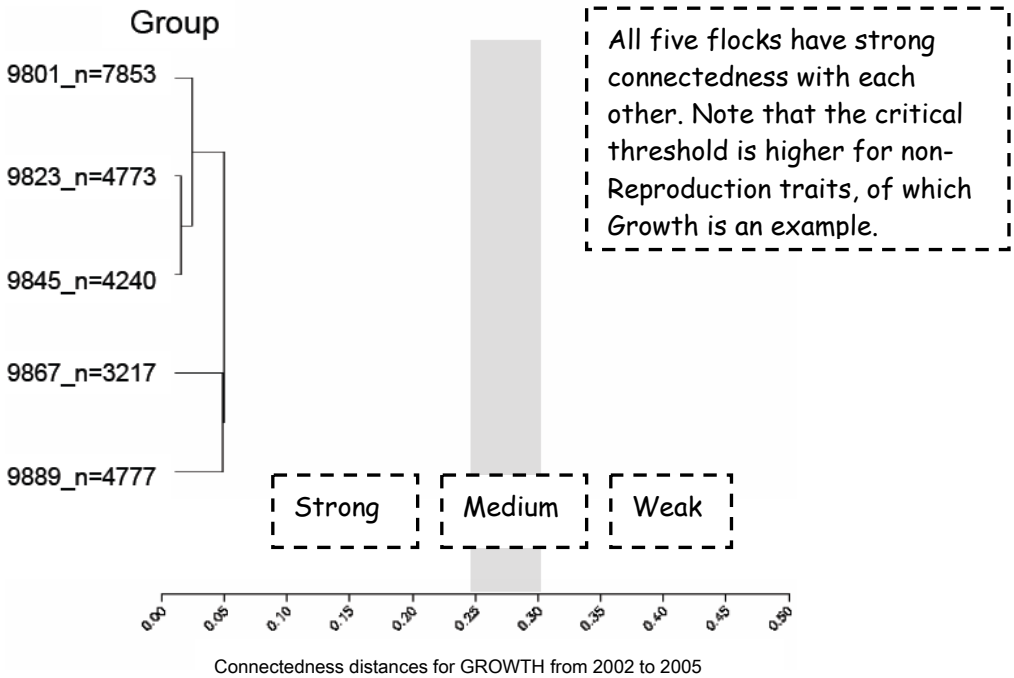
Need more information?

Contact your SIL bureau or call 0800-745-435 (0800-SIL-HELP).

Appendix: Examples of connectedness graphs for Growth and Reproduction.

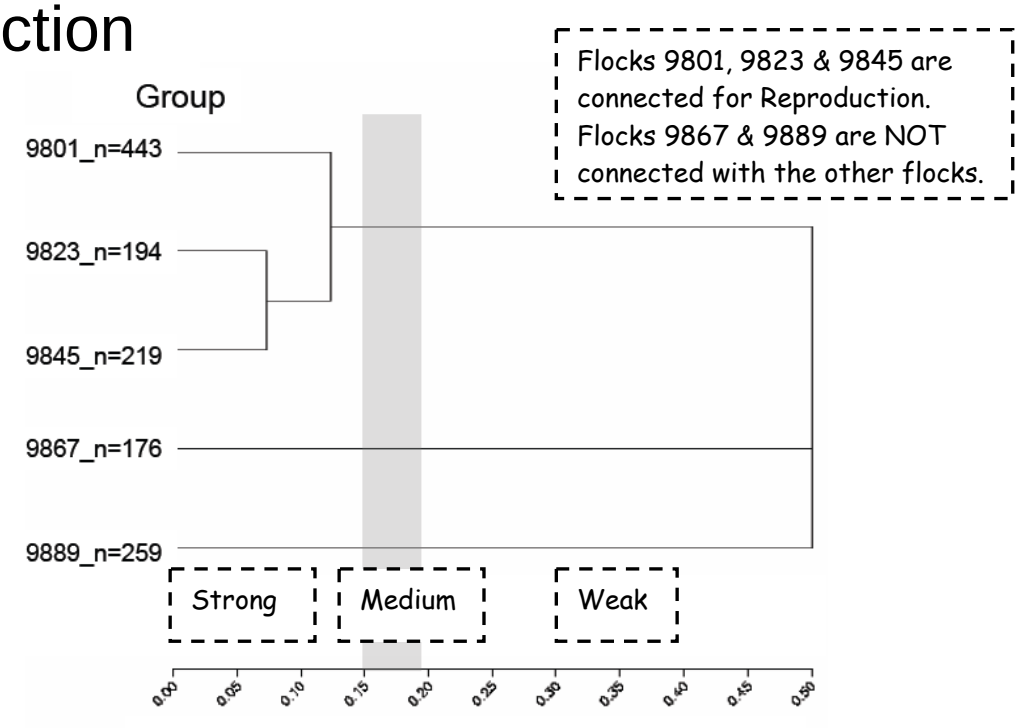
There are 5 flocks (9801 to 9889). The number to the right of the flock number (n=7853 for first flock in first graph) is number of animals with performance records, including progeny of link sires. Critical connectedness thresholds are shown as a grey bar. Flocks connected by lines left of the grey bar have good connectedness. Flocks connected by lines right of the grey bar are weakly, and inadequately connected. NB: Critical thresholds for Reproduction have a lower value (they are tougher!) than for other traits due to lower heritability.

Growth



Connectedness distances for GROWTH from 2002 to 2005

Reproduction



Connectedness distances for REPRODUCTION from 2001 to 2005