*Proceedings of the British Mastitis Conference, 1998, Axient/Institute for Animal Health/Milk Development Council/Novartis Animal Health, p64-60.*

# BULL PROOFS FOR SOMATIC CELL COUNTSError! Bookmark not defined.

**BRIAN McGUIRK,** Genus R and D Project Manager Vallum Farm, Military Road, Stamfordham, Newcastle upon Tyne NE18 0LL

## SUMMARY

In 1997 the Animal Data Centre (ADC) began to publish bull proofs for Somatic Cell Count (SCC). These proofs cover bulls with daughters in the UK, as well as converted proofs from other countries. How these proofs are calculated, how they might be used in sire selection, plus some of the associated research being undertaken on SCC in the UK and elsewhere are described.

## UK SCC PROOF CALCULATIONS

The procedures used to calculate SCC proofs (1), are essentially the same as used for production traits.

The ADC receives the monthly cell count test information from the Milk Recording Organisations (MRO). For each lactation, the geometric mean is calculated for all individual test results, with cows requiring six records per lactation for inclusion. As is the case for the individual test results, these means are not normally distributed, and the data are transformed to logarithms prior to analysis.

The model used by the ADC to predict genetic merit is based on their earlier investigations of UK data, but the procedure is generally similar to that used in other countries.

Non-genetic factors considered in the model include month and age of calving, and lactation number. Data on up to five lactations are used in the analysis, with a repeatability of 0.35 between lactation means. The heritability of SCC is assumed to be 11 percent, lower than for production traits, and this has an impact on the reliability of the resulting bull proofs. Because of the low heritability, there is little point publishing SCC proofs for cows.

As with Animal Models generally, the analysis uses all pedigree information. While proof information on cows is not published, SCC records on dams are used when predicting the merit of their sons. Foreign proofs on sires are included in the calculations where no UK proof is available.

The resulting proofs are presented as percentages. Those with negative values are good, in that they are expected to have daughters with a lower than average cell count. On the other hand, bulls with positive proofs are expected to increase cell count in their daughters. The larger the "number", the bigger the expected impact.

## CONVERTED PROOFS

The UK dairy industry is unusual in that it is a major importer of dairy semen. Major supply countries include the USA, the Netherlands, France and Canada. The normal procedure is that the best bulls tested in these countries are then marketed as soon as their home country proof is available. This applies to proofs for SCC, as well as for production, type and whatever other traits are available.

In addition to calculating proofs using UK daughter records, the ADC is also responsible for establishing conversion formulae, so that foreign proofs can be converted into UK equivalents. These formulae are derived using proof information for bulls with daughters in both the supplying country and the UK. This is a retrospective exercise. However, if these two proofs are highly correlated, then a formula which relates the two proofs can then be used to "predict" how his future UK daughters will fare, based on his home country proof. In short, the formula is then used prospectively.

To date, the ADC has looked at bulls from a number of countries, where they have both a home country and a UK proof for SCC (Table 1). In each case the correlation between the two proofs is very high. In simple terms this means that rankings of bulls for SCC in their home country is a good indication as to how they will ultimately rank in the UK.

**Table 1.** Correlation (as at February 1998) between SCC proofs in foreign countries and the UK

| **Foreign Country** | **No. of Bulls** | **Correlation with UK proof** |
|---|---|---|
| Canada | 46 | 0.88 |
| France | 24 | 0.95 |
| Germany | 40 | 0.86 |
| Netherlands | 66 | 0.90 |
| USA | 36 | 0.88 |

## ACCESS TO SCC PROOF INFORMATION

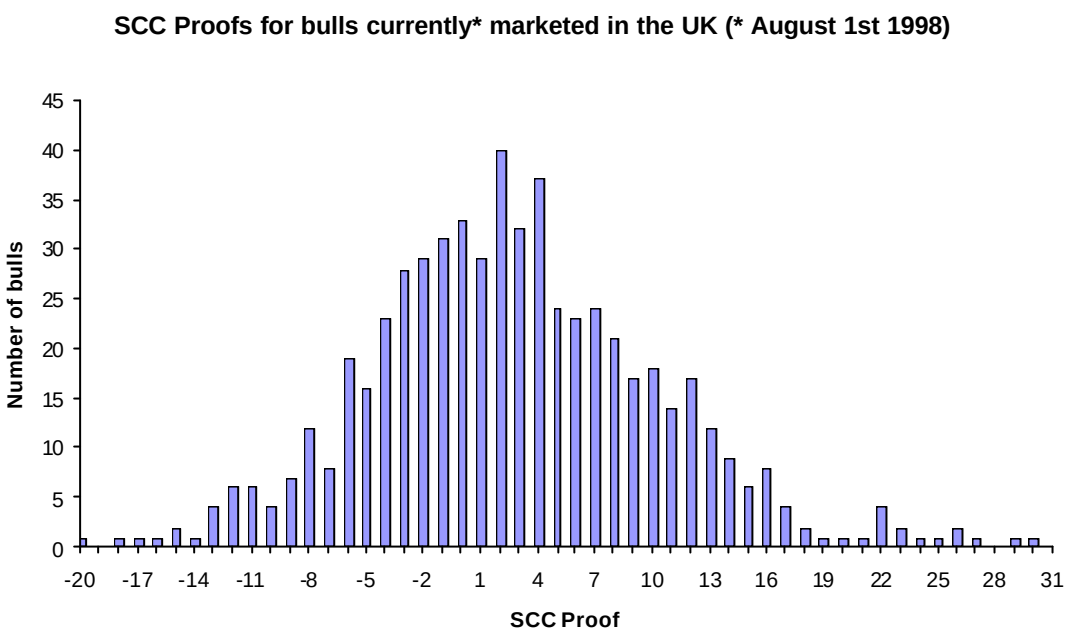
One of the challenges facing the dairy industry is how to get relevant and up to date genetic information out to the potential users. This has become a particular problem, now that proofs are coming out commonly four times a year, from supplying countries whose proof release dates do not always coincide, and where proofs are appearing on a growing and often bewildering array of traits.

An important development has been the creation by the Holstein Friesian Society (HFS) of a web page, where one of the options is a list of bulls currently marketed in the UK, with their up to date proof information. The maintenance of such an accurate bull file has also required considerable input from AI organisations.

There is wide variation in the distribution of SCC proofs for bulls currently marketed in the UK, with either UK or converted proofs. While the distribution is essentially bell-shaped, with most values around the mean, the extreme values vary between minus 20, which we can see as "improvers" for SCC, to plus 30. Thus it is clear AI companies are offering UK farmers a very wide choice as regards genetic merit for SCC.

*Proceedings of the British Mastitis Conference, 1998, Axient/Institute for Animal Health/Milk Development Council/Novartis Animal Health, p64-60.*

**Figure 1**




To assess the likely impact of individual bulls, assume a UK herd which has an average bulk milk cell count close to 200,000 cells/ml, which is close to national average. Against this herd average, bulls with a SCC proof of -15 would be expected to have daughters with average counts of 170,000 cells/ml (15 percent less than the population average). By contrast, the daughters of bulls with a +15 proof might be expected to have an average cell count of 230,000. These figures are approximate in that they assume the herd is close to the national genetic average for SCC, but they indicate the sort of impact that bulls can have on herd cell counts.

## CORRELATIONS WITH OTHER TRAITS

A considerable amount of research has been done, to look at genetic correlations between cell count and production, type or disease traits, and especially mastitis incidence.

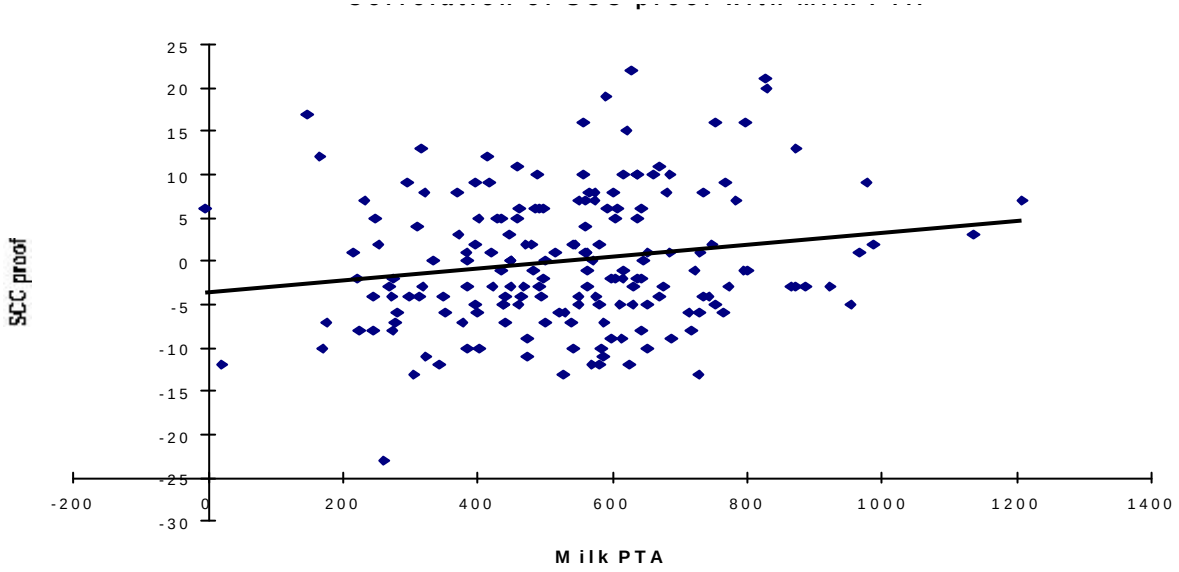
These days, dairy improvement programmes are in the hands of breeding companies, and the major emphasis in most programmes is to increase yield. It is fair to ask what effect this goal might have on cell count.

In almost all studies, higher yields of milk, fat or protein have been found to be associated with higher cell counts. While the correlations are not strong, generally in the region of 0.1 to 0.2, they are quite consistent. Thus a breeding programme geared to improving yields, or a production index such as PIN, would lead to a higher cell count as a correlated response.

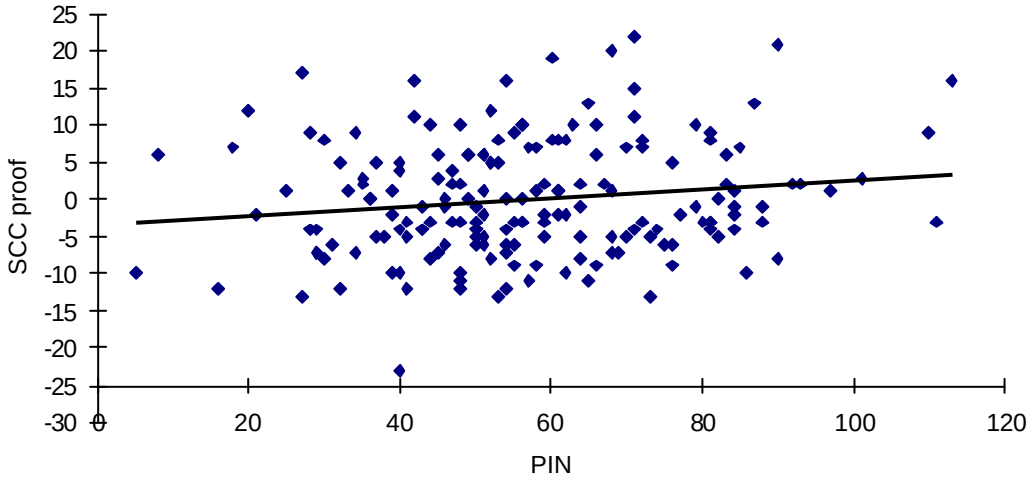
This association between PTA for production and SCC is nicely illustrated in Figs. 2a and 2b, which show associations with PTA for Milk and with PIN for several hundred Genus bulls that were recently progeny tested. The correlations with the SCC proofs are in the range 0.15 to 0.20, which is in line with other research evidence. While the correlation with production is not strong, it is unfavourable. Farmers will obviously have to work even harder on management strategies to keep cell counts at current levels if they select on PIN alone.

**Figure 2 Regression of SCC proofs on (a) Milk PTA and (b) PIN**

**a)**




**b)**




In the UK it has been found (1) that a bull's PTA for SCC is associated with his standardised PTAs for fore udder attachment, udder depth, teat placement side and teat length (Table 2). With sire and dam information available on the trait (SCC) itself, parental assessments on udder and teat traits are probably of limited extra value in preselecting bulls for progeny testing. Nevertheless it is still

reassuring that a favourable (negative) proof is correlated with characteristics thought to indicate sound udders and teats.

**Table 2.** Correlation between UK bull proofs for SCC and Type Traits

| **Type Traits** | **Correlation** | **Favourable SCC proof associated with** |
|---|---|---|
| Fore udder attachment | -0.19 | Strong attachment |
| Udder Depth | -0.19 | Shallow udders |
| Teat placement side | 0.11 | Close teat placement |
| Teat length | 0.13 | Short teats |

One of the major reasons for an interest in SCC is the high genetic correlation with susceptibility to mastitis. For example, a genetic correlation between SCC and clinical mastitis in Denmark of the order of 0.70 has been reported (2). Given the absence of adequate recording schemes for mastitis in many countries, including the UK, SCC provides an appropriate indirect selection criterion.

Further evidence of this genetic association between SCC and mastitis comes from another recent study (3). This looked at SCC proofs in the US, and the subsequent proofs for clinical mastitis for those same bulls, when their daughters were milked in Scandinavia. The correlations between the proofs were -0.66 and -0.49 in Denmark and Sweden respectively (the negative sign is simply an artefact of how proofs are expressed in the different countries), so that this association spans countries.

## HOW MUCH EMPHASIS TO GIVE TO SCC?

In discussing current dairy breeding programmes in the Holstein/Friesian, it is relevant to point out that the direction and pace of genetic changes are determined by selection decisions made by AI organisations. Commercial producers will follow the same general "trajectory", with some scope for a departure to this pattern, mainly as a consequence of sire selection decisions.

How much attention are AI studs paying to SCC proofs? That is not known at present, but probably not much. The main area of competition between AI studs is in genetic merit of their bulls for production, provided they also meet an acceptable standard for type. The emphasis given to any trait will be driven by market demand. Given the emphasis on production in breeding programmes, it is probable that we can expect a gradual deterioration in genetic merit for SCC.

How much attention should SCC receive in a herd's breeding programme? This should depend both on its economic importance and scope for change, relative to other traits that might be considered.

At present it is necessary to identify the economic importance of SCC. The ways in which it achieves economic significance are clear:

- Through price penalties for milk with high cell counts.
- From the negative association between cell counts and daily milk production (4), presumably because high cell counts indicate mammary tissue damage, which then results in lower production, and
- Through its strong association with clinical mastitis.

While it is possible to arrive at reasonable estimates of these latter two effects, if only from the literature, the benefit of breeding for lower cell counts in terms of milk price penalty depends very much on herd bull tank counts. In the UK, with current penalty bands, the choice of bull was shown to be of little consequence for herds of very high or very low cell counts (5), as it would not move the herd from one penalty band to another. However, herds with bulk cell counts in the intermediate range, of around 200,000 cells/ml, could benefit substantially from even small changes in cell count, as choosing a bull with a low SCC proof could move the herd to a lower penalty band.

As if this non-linear association was not a sufficient problem, it is necessary to define the economic importance of a trait when daughters start milking, which is about three years after semen purchase decisions are made. It is not easy to predict price penalty schemes for bulk tank SCC that far ahead.

Work on the economic importance of SCC is continuing in the UK within a project on Sustainable Breeding Goals, funded by MAFF, the Milk Development Council and the HFS. The plan is to include SCC information along with production and type proofs, probably into an index such as ITEM, where the aim is a ranking on overall economic performance.

What might be done in the interim? The initial screening of potential AI sires should still be on an index of overall merit, such as PIN or ITEM. Bulls meeting those standards can then be subject to further selection on traits such as SCC, just as they might now for particular type traits, calving ease etc.

## HOW FAR TO GO IN REDUCING CELL COUNTS?

The reasons why SCC proofs should be of interest to individual farmers and, more importantly, to breeding organisations have already been outlined. However, a frequently asked question is how far to proceed along that route, and whether in fact breeding for low cell counts may not lead to animals which are immunologically incompetent. Specifically, animals with very low cell counts may in the end have a higher incidence of mastitis.

Several studies from Scandinavia give little support to this concern.

Several years ago, Philipsson, Ral and Berglund (6) looked at Swedish data, where there are good records on both SCC and clinical mastitis, and where bull proofs are calculated independently for these traits. They looked at the regression of the Mastitis Proofs on the SCC proofs, and found a straightforward linear relationship. Within the current population of bulls, selecting those with extreme low SCC proofs would lower the incidence of mastitis in the next crop of daughters.

Similar evidence along the same lines has now emerged from a recent study (3). This also looked at the regression of Mastitis proof on SCC proofs. However, in this case the Mastitis proofs were either Swedish or Danish, while the SCC proofs were from the US. The 80 bulls included in the study were all born and tested in the US, and subsequently sired Scandinavian daughters when marketed there.

Both of these studies indicate that selecting sires with favourable SCC proofs should reduce both SCC levels and the incidence of mastitis in their daughters. Of course it is still possible that individual cows with extremely low SCC may be particularly susceptible to udder infection. But at the level of daughter average performance, which is all that a sire proof describes, this is certainly not the case.

## ACKNOWLEDGEMENTS

Raphael Mrode of the ADC provided useful discussions and Matthew Winters helped with the HFS web site. The R and D Project on Sustainable Breeding Goals is jointly funded by the MDC, MAFF and the Holstein Friesian Society.

## REFERENCES

1. MRODE R A, G J T SWANSON & M S WINTERS (1998). Animal Science 66 569-576
2. EMANUELSON U, B BANELL & J PHILIPSSON (1988) Journal of Dairy Science 71 467-476
3. ROGERS G W, G BANOS, U SANDLER NIELSEN & J PHILIPSSON (1998) Journal of Dairy Science 81 1445-1453
4. GILL R, H H HOWARD, K E LESLIE & K LISSEMORE (1990) Journal of Dairy Science 73 3340-3348
5. VEERKAMP R F, A W STOTT, W G HILL & S BROTHERSTONE (1998) Animal Science 66 293-298
6. PHILIPSSON J, G RAL & B BERGLUND (1994) Livestock Production Science 41 195-200