CURRENT STATUS OF GENETIC EVALUATION OF SOMATIC CELL SCORES FOR US DAIRY CATTLE

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SUMMARY
Predicted transmitting abilities (PTA) for somatic cell scores (SCS) have been calculated and released to the US dairy industry since 1994. Phenotypically, SCS appear to be decreasing on a population basis, but genetic trends are small. Genetic trends among bulls sampled by artificial-insemination (AI) organizations also are small. Correlations of sire PTA for SCS and PTA for yield traits were near 0, but correlations of PTA for SCS with PTA for productive life were near −.30 for Holsteins.
Keywords: genetic evaluation, somatic cell score, genetic trend, phenotypic trend, dairy cattle

INTRODUCTION
National genetic evaluations for SCS, an indicator of mastitis in dairy cattle, have been calculated in the United States since January 1994. Some countries, especially Scandinavian countries, have evaluated dairy cattle for genetic merit for this trait longer, while other countries like Canada and the United Kingdom have implemented genetic evaluations for SCS more recently. Background and methodology for animal model evaluation of SCS in the United States were reported by Boettcher *et al.* (1992), Shook and Schutz (1994), and Schutz *et al.* (1995). The PTA for SCS are released to the dairy industry for all evaluated bulls and cows and are half the breeding values from analysis of lactation mean SCS records using a lactation repeatability model. The objectives of this paper were to characterize genetic evaluation of SCS in the United States and to examine genetic trends for US dairy cattle.

MATERIALS AND METHODS
Data included PTA of bulls with May 1997 USDA-DHIA genetic evaluations. Genetic evaluation methods have been outlined by Schutz (1994). The edits used for SCS records have been the same as for yield records to ensure validity of identification and birth and calving dates. Prior to evaluation, SCS records are adjusted for lactation stage, age, and calving season (Schutz *et al.* 1995). In January 1994 when genetic evaluations for SCS were initiated, records were discarded if the number of tests was small compared with lactation length. Since July 1994, records with few SCS samples have been included by adjusting individual test-day SCS to a 305-day basis (VanRaden and Wiggans 1994; Wiggans and Shook 1987). Since January 1995, multiplicative instead of additive factors have been used to adjust SCS records prior to evaluation (VanRaden *et al.* 1995). Age-parity effects also have been included in the model since January 1995.

Statistics were available for genetic evaluations for all US breeds of dairy cattle, but only Holstein results are reported for brevity. Phenotypic mean SCS of first lactation heifers and mean breeding values of their sires were obtained for all Holstein cows. Trends in PTA for SCS were summarized for all Holstein bulls sampled by AI organizations and represented US bulls with the most impact. Correlations of PTA for SCS with PTA for other traits were calculated using data from 8718 Holstein bulls with a reliability of ≥.60 for PTA for SCS from May 1997 USDA-DHIA genetic evaluations.

RESULTS AND DISCUSSION
Numbers of lactations and levels of effects, other than breeding values, for national genetic evaluation of SCS have nearly doubled since initial evaluation in 1994. In May 1997, 8,888,156 Holstein lactation records were available for genetic evaluation, and number of levels of effects in the animal model included 972,887 management groups, 4,294,699 permanent environments, 1,979,141 herd-sire interactions, and 7,778,370 breeding values. Earliest SCS records date back to 1987, but some dairy records processing centers only began to contribute SCS records in 1994, which accounts for the dramatic increase in records over the past 3 years.

Figure 1 shows mean phenotypic SCS of first lactation heifers and mean breeding values for SCS of their sires by birth year. Breeding values for SCS have been augmented by adding a constant of 3.20, which is the mean phenotypic SCS of first-lactation Holstein heifers born in 1990. This constant, which differs by breed, is added to all reported PTA for SCS to put them on a more interpretable scale for breeders. The earliest possible birth date for heifers resulting from matings that may have considered PTA for SCS was November 1994. Assuming an age of freshening of 2 years, those heifers would have completed no more than 4 months of lactation prior to data cutoff dates for May 1997 USDA-DHIA evaluations. Records based on few tests receive relatively less weight in genetic evaluations; therefore, animals resulting from SCS selective matings are not likely to have had much impact on genetic progress to date.

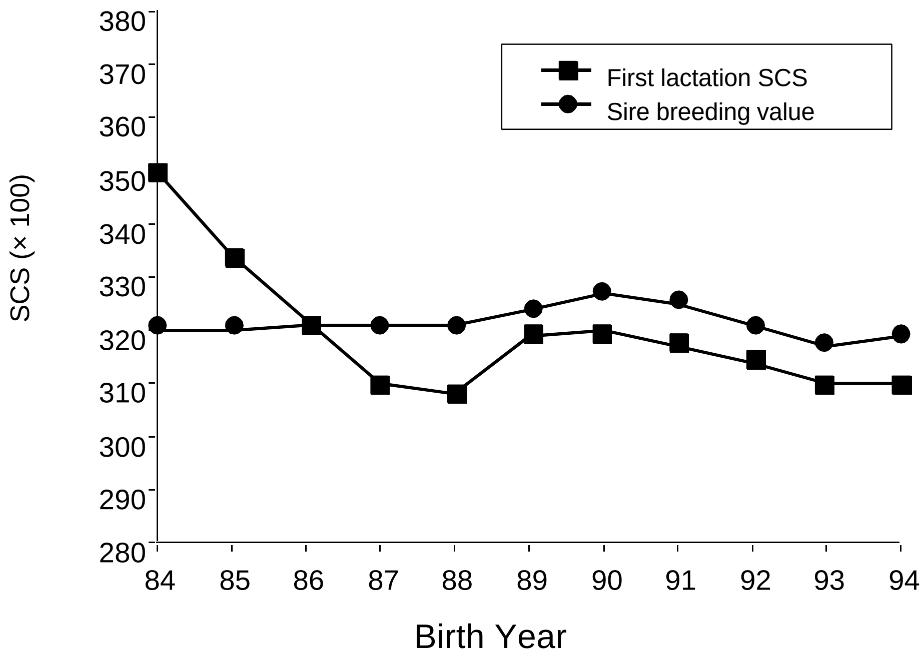

Figure 1. Mean first-lactation somatic cell scores (SCS) of Holstein heifers and mean breeding values of their sires for SCS from May 1997 USDA-DHIA genetic evaluations by birth year of heifers.

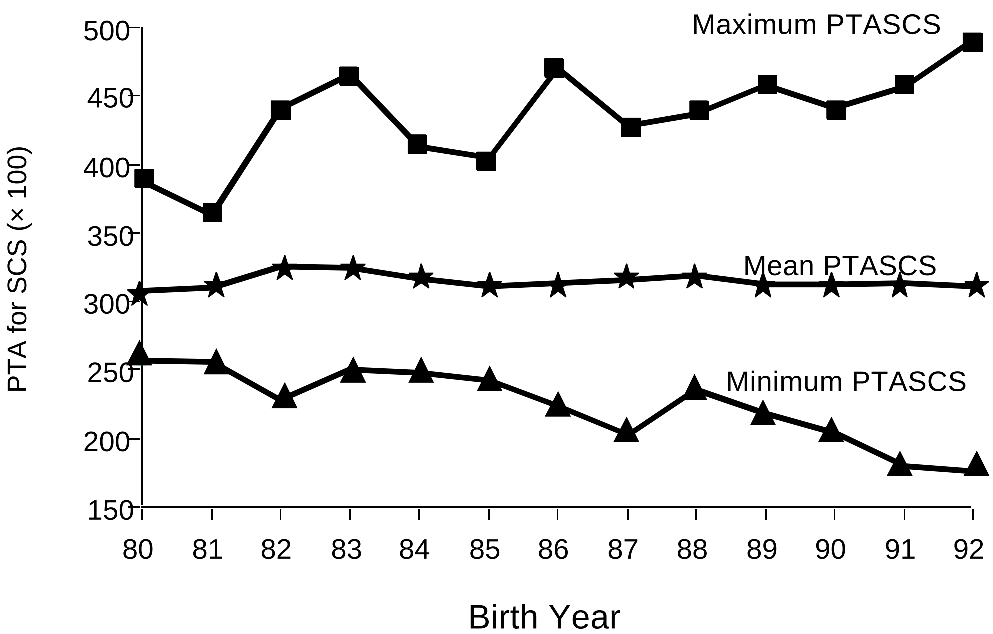

Figure 2. Mean, maximum, and minimum predicted transmitting abilities (PTA) for somatic cell score (SCS) of Holstein bulls sampled by artificial insemination organizations from May 1997 USDA-DHIA genetic evaluations by birth year of bulls.

Mean, maximum, and minimum PTA for SCS of Holstein bulls sampled by AI organizations from May 1997 USDA-DHIA genetic evaluations are in Figure 2 by birth year. Little genetic trend is apparent based on mean Holstein PTA for SCS, but maximum and minimum PTA for SCS tended to diverge from the mean over time. No differences in variances of PTA for SCS were detected over time. Although this phenomenon could be explained by chance, VanRaden *et al.* (1997) reported that regression of final PTA on initial PTA was higher for SCS than for other traits. The regression coefficient of 1.16 (compared with an expected value of 1.00) indicated an increase in PTA of individual bulls over time, which may relate to the imperfect correlation between SCS in first and later lactations discussed by Pösö and Mäntysaari (1996). Canada recently has begun evaluations considering SCS to be a separate but correlated trait for first, second, and third lactations (Reents *et al.* 1995).
Correlations of bull PTA for SCS with PTA for other traits were .06 for milk yield, −.04 for fat yield, .05 for protein yield, −.10 for fat percentage, −.03 for protein percentage, and −.33 for productive life). The antagonistic relationship of SCS with milk yield and the larger negative relationship with productive life emphasizes the importance of using PTA for SCS in a selection index such as net merit dollars.

CONCLUSIONS

Genetic trends for SCS continue to be small. Heifers resulting from matings that may have considered initial PTA for SCS in 1994 would not yet have completed lactations, and corresponding young sires entering sampling programs will not have offspring with records for some time. Hence, changes in genetic trends were not expected to be impacted by availability of PTA for SCS yet. Because of recommendations to include PTA for SCS in an index with appropriate weight, genetic trend for SCS should remain steady. Future monitoring of genetic trends will be necessary to evaluate the role of PTA for SCS as a selection tool. Further sophistication of genetic evaluation procedures, such as test day models, considering SCS to be a different trait in different lactations, and inclusion of other correlated information like udder traits, clinical mastitis incidence, and electrical conductivity of milk, should be explored.

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