A National Sire Fertility Index

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INTRODUCTION

Estimated relative conception rate (**ERCR**) was initiated in 1986 by Dairy Records Management Systems (**DRMS**; Raleigh, NC) as a fertility evaluation for service sires (Clay, 1987). Those phenotypic evaluations were based on a 70-d nonreturn rate (**NRR**) to first service as reported in breeding records supplied by Dairy Herd Improvement (**DHI**) participants and compared bulls across artificial-insemination (**AI**) organizations (Animal Improvement Programs Laboratory, 2006). An ERCR was provided to dairy producers for any AI bull with enough inseminations to produce an accurate prediction of future breeding success. Many in the AI industry were concerned at first that ERCR would destroy the marketing potential for AI bulls with less than average fertility. However, AI organizations eventually began to rely extensively on ERCR information as the use of insemination technicians declined and the demand for reproductive information grew. Today AI organizations and dairy farmers want reliable information on the fertility of marketed bulls.

Computerized DHI data made calculating a fixed NRR convenient, because those data were readily accessible and updated continuously. Data from cows that left the herd or were in herds that discontinued DHI testing prior to 70 d after first service were easily excluded from ERCR calculations, which was necessary to prevent bias in the evaluation. The ERCR evaluations included information on first-service inseminations from the most recent 3 yr period. Those data were supplied by DRMS (Raleigh, NC, and Ames, IA) and AgSource Cooperative Service (Verona, WI), as well as by Minnesota DHI (Buffalo, MN), which had data processed by AgriTech Analytics (Visalia, CA).

In 2003, AgriTech Analytics introduced the Western Bull Fertility Analysis (**WBFA**). In comparison to ERCR, which was derived largely from eastern and midwestern U.S. herds, WBFA is based primarily upon on-farm computer data from a few large herds in the western United States. Two positive features of WBFA are that it is based on 75-d veterinary-confirmed conception rate (**CR**) using available pregnancy-check codes, rather than on NRR, and that it includes up to 5 services/cow/lactation (Weigel, 2006); thereby utilizing more of the available data. The entire breeding history for each bull is included in his WBFA evaluation; his breeding success is not restricted to the most recent years and, therefore, may not reflect recent changes in semen quality as well as ERCR does.

In May 2006, USDA's Animal Improvement Programs Laboratory (**AIPL**) assumed the responsibility for producing evaluations for bull fertility (Kuhn et al., 2006a). Initially, ERCR evaluations were implemented without a change in methodology, so that future revisions could be adequately researched and reviewed. At the same time, an effort was made to broaden the scope of the data used for bull fertility evaluations. An intense research investigation primarily by Dr. Melvin Kuhn led to a new procedure called *sire conception rate* (**SCR**), which was implemented by AIPL in August 2008 and replaced ERCR (Norman et al., 2008). The SCR gives the probability that a specific bull's straw of semen will result in a pregnancy when compared with other bulls that could have been used. Kuhn and Hutchison (2008) had confirmed that genetic control of bull CR is virtually zero based on field results, which implies that most deficiencies in sperm morphology have been removed during semen processing. This paper provides a general description of the SCR procedure, some results to show the justification for the selected evaluation method, and some characteristics describing its practical effectiveness.

NATIONAL SCR EVALUATIONS

Data

Only AI inseminations with known outcomes are included in SCR, and each insemination has only 2 possible outcomes: success (1) or failure (0). All available relevant information such as subsequent services, calving dates, pregnancy examination results, *do not breed* designations, and termination codes are used in confirming pregnancy status for each insemination. Three dairy records processing centers (AgriTech Analytics, AgSource Cooperative Service, and DRMS) contributed over 99 % of the data for the August 2008 SCR, which included data from 46 states and Puerto Rico.

Inseminations are first through seventh services for cows in first through fifth lactations. Lactation length at breeding is limited to 30 to 365 DIM. Cow age is between 2 and 15 yr. Standardized milk yield has to exceed 10,000 lb for Holsteins, 8,000 lb for Brown Swiss, and 6,000 lb for all other breeds. Inseminations are excluded for any lactation for which the cow is coded an embryo transfer donor as are inseminations with any indication that they originated from sexed semen. Inseminations also are eliminated if consecutive services are within 10 d of each other; only information from the later service is kept, and the earlier service is not considered when assigning subsequent service numbers for the same lactation. All inseminations for a herd are eliminated if $\geq$ 50 % of the herd's milking cows do not have a recorded breeding or if the herd's CR is < 10 % or > 90 %. In addition, service sires must be $\geq$ 0.8 yr old and have known inbreeding coefficients.

Heifer inseminations are not included in SCR, because they have been shown to be a somewhat different trait (Kuhn et al., 2006b). Evaluations based on heifer inseminations also are more suspect because some sexed-semen matings, which have a somewhat lower CR (Seidel et al., 1999), may not be coded as such.

Only inseminations from the most recent 4 yr of breeding records are used for SCR evaluations. All inseminations must have occurred $\geq$ 70 d before the data submission deadline for the evaluation. Currently, insemination data are evaluated and reported on a within-breed basis for 6 traditional U.S. dairy breeds: Ayrshire, Brown Swiss, Guernsey, Holstein, Jersey, and Milking Shorthorn. When heterosis is eliminated as a concern (after future examination or through adjustment), inseminations used for crossbreeding will be included in SCR evaluations as well.

Development of SCR

Two approaches were used in developing SCR evaluations. First, factors were identified that were related to the bull that provided the unit of semen and that could help to improve the prediction of whether that unit of semen resulted in a pregnancy. Second, factors were identified that were related to the cow receiving the unit of semen that could distort the fertility measure for the bull providing the semen (nuisance variables). Those nuisance variables were accounted for to produce the best predictor of the bull's true capability for impregnating cows.

Bull Factors

Because the probability that an insemination results in a conception is impacted by the quality of the semen and the manner in which it is handled during the insemination process, bull characteristics and their change over time were examined. Those characteristics are referred to as the *expanded service-sire effect* and include inbreeding of the service sire as well as the resulting embryo; bull age; the AI organization that collects, processes, and distributes the semen combined with the year of the mating; and the effect of the bull itself. Some of those factors are controlled directly by the AI organization that supplies the semen. Kuhn and Hutchison (2008) reported how the constants for AI organization within mating year had changed with time.

Cow Factors

Cow factors also influence the probability of a successful insemination and are largely determined within the herd where the semen is used. Such nuisance variables include the combined effect of herd, year of mating, cow parity, and cow registry status; the month and year of mating combined with the state in which mating occurred; cow parity; service number; a short interval between matings; cow age; cow standardized milk yield; and both the permanent environmental and genetic effects of the cow. Those factors distort the bull fertility measure unless accounted for and removed. To obtain the most accurate predictor of a bull's CR, the effect of nuisance variables on prior matings must be considered. This was done by identifying all potentially influencing effects, determining which have an impact, and accounting for those through inclusion in the statistical model (Kuhn et al., 2008).

Model

Cassell (2008) described SCR as "the most complex model that I know of to evaluate animal performance" based on the number of individual effects included in the evaluation model. Categorical fixed effects include individual parities for lactations 1 to 5; state-year-month of insemination group; 6 standardized milk yield groups; service number for

Table 1. Reliabilities and 80 % confidence interval by number of inseminations.

Inseminations, n	Reliability, %	80 % Confidence Interval
200	43	± 2.2
300	54	± 2.0
500	66	± 1.7
1,000	79	± 1.3
2,000	88	± 1.0
5,000	95	± 0.7
10,000	97	± 0.5
15,000	98	± 0.4
20,000	99	± 0.3

inseminations 1 to 7; cow age, rounded to nearest year (2, 3, …, ≥ 8 yr); and herd-year-season-parity-registry status class (six 2-mo seasons starting in January, parity of 1 or ≥ 2, and registry status of registered or grade). Covariate effects for service-sire and mating inbreeding coefficients were linear regressions fit as deviations from overall mean. Random effects included service-sire age group (up to 12 groups depending on breed); AI organization-insemination year group (4 rolling year categories); individual service sire; cow's genetic ability to conceive; cow's permanent environmental effect; and residual. Variances estimated by Kuhn et al. (2008) were 0.00014 for service-sire age group, 0.00011 for AI organization-insemination year group, 0.00054 for service sire, 0.00294 for cow, 0.00533 for cow's permanent environment, and 0.196970 for the residual.

Accuracy

Reliability (**R**) for SCR is calculated as R = n/(n + 260), where n is the number of inseminations. The constant 260 was derived by including all random effects in the expanded service sire term. The confidence interval (**CI**) for SCR is calculated by: $\mathrm{CI} = 1.282(0.02313)\sqrt{1-\mathrm{R}}$, where 0.02313 is the true standard deviation of SCR and 1.282 is the standard normal variate from the normal distribution for an 80 % CI. The relationships among number of inseminations, R, and 80 % CI are shown in Table 1. A bull with 300 inseminations (the minimum for Holstein SCR release) has an R of 54 %; R for bulls with 1,000 and 10,000 inseminations is 79 and 97 %, respectively. As an example, a bull with an R of 54 % and an SCR of 1.0 % would have an 80 % expectation that his true CR was between −1.0 and 3.0 % (his SCR of 1.0 % plus or minus his CI of 2.0 %). His SCR might have been different if he had had more inseminations, so that it could have been predicted more accurately. The CI are smaller for the bulls with more inseminations; e.g., bulls with 1,000 and 10,000 inseminations have an 80 % CI of ± 1.3 % and ± 0.5 %, respectively. If those bulls also had an SCR of 1.0 %, then their true CR would have an 80 % expectation of being between −0.3 and 2.3 % (1.0 ± 1.3 %) and between 0.5 and 1.5 % (1.0 ± 0.5 %), respectively.

An 80 % CI table is being developed for SCR evaluations. Table 2 is an example of the proposed table format using SCR information from August 2008. Hopefully the table will clarify differences among bulls and prevent confusion that might result because of conflicting CI from different sources.

Table 2. Example of proposed table of 80 % confidence intervals for sire conception rate evaluations based on August 2008 data.

Bull name	Sire conception rate, %	Reliability, %	80 % Confidence Interval
A	1.6	99	1.3 to 1.9
B	0.8	98	0.4 to 1.2
C	−0.4	90	−1.3 to 0.5
D	1.1	82	−0.2 to 2.4
E	−3.8	77	−5.2 to −2.4
F	2.3	59	0.4 to 4.2

Release of Evaluations

An SCR evaluation is released only for AI (active service and progeny test) bulls that are ≤ 15 yr old. For Holsteins, AI bulls must have ≥ 300 matings overall and ≥ 100 matings during the current 12 mo period in ≥ 10 herds. For Ayrshires, Brown Swiss, Guernseys, and Jerseys, the minimum for total matings is 200. The minimum for matings during the current 12 mo period is reduced to 30 matings in 5 herds for Ayrshires, Brown Swiss, and Guernseys. Corresponding limits for Milking Shorthorns are 100 matings overall and 10 matings during the current 12 mo period in 5 herds. The SCR evaluations are released 3 times a year in January, April, and August in conjunction with USDA's national genetic evaluations.

Interpretation of SCR

An SCR evaluation is a phenotypic predictor of bull fertility expressed as a relative CR and reported as a percentage. An average bull has an SCR of 0.0 %, and the standard deviation for August 2008 SCR was 2.37 %. A bull with an SCR of 3.0 % is expected to have a 3 % higher CR than an average bull and a 6 % higher CR than a bull with an SCR of − 3.0 %.

How SCR evaluations should be used remains largely unchanged from how ERCR evaluations were used. Technically, 70-d NRR and CR differ in that CR is based on confirmed pregnancy. However, the 2 traits are highly related when based on information from the same cows. A bull with an SCR of 2.0 % is expected to have a CR of 32 % in a herd that normally averages 30 % and historically has used bulls with average SCR. The term *expected* indicates what the results would be if based on extremely large numbers of matings. Obviously, a herd with only 2 inseminations from a bull could realize only a CR of 0, 50, or 100 % for his matings.

MODEL SELECTION

Impact of Individual Effects

To evaluate the impact of each individual effect in the model, alternative evaluations were calculated by sequentially removing the individual effect for service-sire or mating inbreeding, service-sire age group, or AI organization-insemination year group from the full model. Then each effect was added back to the model and another effect was removed. All possible combinations of model effects (e.g., removal of 2 or 3 effects) were not evaluated because computing demands were prohibitive.

Including continuous service-sire age as a linear-quadratic effect or as an interpolated effect rather than as a group effect also was examined. The 3 alternatives for including age in the model each have advantages and disadvantages. A random categorical age effect can fit data better if the effect deviates from a linear-quadratic response. Interpolated age eliminates abrupt changes on specific days of the year. For example, if service-sire ages were assigned to groups based on calendar year, a bull's categorical age effect would remain constant from January 1, 2007 through December 31, 2007, and then have a potentially large change on January 1, 2008. Interpolated age produces a more gradual change and reduces the variation between subsequent evaluations.

Correlations between January 2008 evaluations based on the full model and evaluations based on a model with a single effect removed are shown in Table 3. Removing either of the inbreeding effects did not change bull rankings much, either across or within AI organization. The impact of including those 2 effects was smaller than including the other effects. As expected, the AI organization-insemination year effect did not change bull rankings within AI organization (correlations of 1.00), but it impacted rankings across AI organizations, as evidenced by the correlation of 0.98.

The effect with the largest impact on predicting SCR was service-sire age, which was similar (correlations around 0.95) across and within AI organization. Including service-sire age as a linear-quadratic effect produced correlations consistently around 0.97. Correlations for the interpolation method (0.98 to 0.99) did not differ markedly from those from the full model with a random categorical effect. However, interpolated age is expected to provide most consistent evaluations across time. Age effects for SCR are not intended to facilitate comparison of bull rankings at a common age (e.g., at maturity as is done for genetic evaluations for yield traits). Instead, they provide a more accurate representation of the phenotypic value of the CR for a bull's semen at this point in his life; i.e., the best prediction of SCR for a semen straw that will be used for an insemination today rather than a lifetime measure. Kuhn and Hutchison (2008) reported that CR increased from around 22 to 27 % for bulls

Table 3. Comparison of differences between models for sire conception rate of Holstein bulls[1] across and within artificial-insemination (AI) organizations based on data for calculation of January 2008 sire conception rates.

	AI organization						
Statistic	All	A	B	C	D	E	F
Correlation between full[2] and alternative models							
No mating inbreeding	1.00	1.00	1.00	1.00	1.00	1.00	1.00
No service-sire inbreeding	1.00	1.00	1.00	1.00	1.00	1.00	1.00
No AI organization-insemination-year	0.98	1.00	1.00	1.00	1.00	1.00	1.00
No service-sire age group	0.95	0.95	0.95	0.95	0.94	0.93	0.92
Continuous age (linear, quadratic)	0.97	0.97	0.97	0.97	0.97	0.96	0.96
Interpolated age	0.99	0.99	0.99	0.99	0.99	0.98	0.98
Standard deviation							
Full model	2.40	2.30	2.25	2.14	2.28	1.97	1.93
No mating inbreeding	2.40	2.31	2.25	2.14	2.28	1.97	1.93
No service-sire inbreeding	2.39	2.30	2.24	2.14	2.27	1.98	1.92
No AI organization-insemination-year	2.34	2.41	2.33	2.21	2.36	2.04	2.02
No service-sire age group	2.43	2.38	2.25	2.27	2.26	1.97	1.91
Continuous service-sire age (linear, quadratic)	2.44	2.37	2.26	2.24	2.30	1.97	1.97
Interpolated service-sire age	2.33	2.24	2.15	2.08	2.20	1.88	1.84
Actual mean difference from full model							
No mating inbreeding	0.00	0.00	−0.01	0.00	0.02	−0.01	−0.01
No service-sire inbreeding	0.00	0.01	0.00	−0.01	0.00	0.01	0.00
No service-sire age group	0.00	0.00	−0.05	−0.09	0.09	−0.06	0.01
Continuous service-sire age (linear, quadratic)	0.00	−0.01	−0.08	−0.03	0.05	−0.07	0.07
Interpolated service-sire age	0.00	−0.02	−0.04	−0.01	0.02	−0.01	0.00
Absolute mean difference from full model							
No mating inbreeding	0.03	0.02	0.02	0.03	0.01	0.03	0.02
No service-sire inbreeding	0.06	0.05	0.05	0.06	0.06	0.06	0.05
No service-sire age group	0.66	0.69	0.64	0.65	0.71	0.64	0.70
Continuous service-sire age (linear, quadratic)	0.48	0.48	0.44	0.44	0.50	0.46	0.53
Interpolated service-sire age	0.25	0.27	0.26	0.21	0.27	0.27	0.25
Standard deviation of actual difference							
No mating inbreeding	0.05	0.05	0.05	0.05	0.05	0.05	0.05
No service-sire inbreeding	0.09	0.07	0.07	0.11	0.09	0.09	0.08
No service-sire age group	0.74	0.76	0.73	0.71	0.77	0.71	0.76
Continuous service-sire age (linear, quadratic)	0.55	0.56	0.52	0.51	0.57	0.53	0.58
Interpolated service-sire age	0.34	0.37	0.36	0.31	0.36	0.36	0.35
Standard deviation of absolute difference							
No mating inbreeding	0.04	0.04	0.04	0.05	0.04	0.05	0.04
No service-sire inbreeding	0.07	0.06	0.06	0.09	0.07	0.07	0.07
No service-sire age group	0.32	0.34	0.34	0.30	0.30	0.32	0.30
Continuous service-sire age (linear, quadratic)	0.28	0.29	0.28	0.26	0.29	0.27	0.25
Interpolated service-sire age	0.24	0.24	0.24	0.23	0.25	0.25	0.23

[1] Number of bulls across AI organizations was 2,163; number of bulls within AI organization ranged from 176 to 524.
[2] Full model includes categorical fixed effects for parity, state-year-month of insemination group, standardized milk yield group, number of services, cow age, and herd-year-season-parity-registry status class; covariate effects for service-sire and mating inbreeding; and random effects for service-sire age group, AI organization-insemination year group, service sire, cow's genetic ability to conceive, cow's permanent environmental effect, and residual.

between 2 and 5 yr of age and then declined gradually to around 25 %.

For an individual bull, maximum absolute change from the January 2008 full-model evaluation was 2.2 percentage units with AI organization-insemination year removed, 1.9 with service sire-age group removed, 1.0 with continuous age included, 0.9 with interpolated age included, 0.8 with service-sire inbreeding removed, and 0.2 with mating inbreeding removed. Even though several effects are included in the evaluation model, they may not represent true biological differences optimally; because semen may be not used equitably across all groups.

Effectiveness of SCR

Prediction of Future CR

The alternative models in section 3.1 were used to generate Holstein SCR evaluations based only on data prior to July 2006 to determine how effective each model was in predicting later data (July 2006 through January 2008). The single effects removed in the alternative models for comparison to the full model were mating and service-sire inbreeding, service-sire age group, and AI organization-insemination year. Including continuous service-sire age as an interpolated effect rather than as a group effect also was examined. All bulls had July 2006 evaluations based on ≥ 300 inseminations and either ≥ 100 or ≥ 300 inseminations included in the later data. Average CR for later inseminations was calculated from deviations of the outcome for each later insemination from the average outcome of all inseminations in the same herd-year-season. Basing CR for later inseminations on those deviations removed herd fertility differences, which made each insemination a better representation of the bull's fertility.

Correlations of July 2006 SCR with CR for later inseminations were calculated on a bull basis and on an insemination basis (Table 4). Correlations on a bull basis were around 0.62 for bulls with ≥ 100 inseminations and 0.65 for bulls with ≥ 300 inseminations; corresponding correlations on an insemination basis were 0.030 and 0.031. Except for mating inbreeding, SCR from each model with a missing effect generally was less useful in predicting later-insemination CR. For correlations on both bull and inseminations bases and for bulls with ≥ 100 or ≥ 300 inseminations, removing the model effect for service-sire age group decreased prediction accuracy the most (1 to 3 %), and including interpolated bull age increased prediction accuracy the most (0.3 to 0.4 %). Removing the effect of mating inbreeding also increased prediction accuracy slightly. However, correlation differences among alternative models were small on both bull and insemination bases.

The AI industry had expressed concern that the most recent AI organization-year might not always be the optimal choice for predicting future CR, because semen from a few bulls is primarily stored with no more being processed. An attempt was made to use AI status to assign bulls to AI organization-years. For example, a bull that was first reported as inactive in May 2005 would have an AI organization-year of 2004 or 2005 for calculating his SCR; whereas active AI and progeny-test bulls (bulls that were presumably still alive) would have the most recent AI organization-year. That approach was not as effective in predicting future CR as simply assigning all bulls to the most recent AI organization-year; assigning bulls to the AI organization-year just prior to the most recent also was of considerable value in predicting future CR. Additional studies to determine the optimal method for selecting AI organization-year for predicting future CR applied multiple-regression methods to July 2006 SCR. Among selection methods, prediction of future CR was improved most by including the 2 most recent AI organization-years and assigning a weight of 60 % to the most recent year and 40 % to the previous year.

Table 4. Correlations of sire conception rate based on alternative models and inseminations before July 2006 with predictions of conception rate[1] based on inseminations from July 2006 through January 2008.

	Correlations on a bull basis		Correlations on an insemination basis	
Model	Bulls with ≥ 100 inseminations	Bulls with ≥ 300 inseminations	Bulls with ≥ 100 inseminations	Bulls with ≥ 300 inseminations
Full model[2]	0.6213	0.6526	0.0306	0.0297
No mating inbreeding	0.6222	0.6536	0.0306	0.0297
No service-sire inbreeding	0.6189	0.6497	0.0305	0.0296
No AI organization-insemination-year	0.6179	0.6488	0.0304	0.0295
No service-sire age group	0.6089	0.6326	0.0304	0.0288
Interpolated service-sire age	0.6238	0.6549	0.0308	0.0298

[1] Calculated from deviations of the outcome for each insemination from the average outcome of all inseminations in the same herd-year-season.
[2] Full model includes categorical fixed effects for parity, state-year-month of insemination group, standardized milk yield group, number of services, cow age, and herd-year-season-parity-registry status class; covariate effects for service-sire and mating inbreeding; and random effects for service-sire age group, AI organization-insemination year group, service sire, cow's genetic ability to conceive, cow's permanent environmental effect, and residual.

Table 5. Herd conception rate (%) by herd and sire fertility levels based on data for August 2008 sire conception rates.

	Herd fertility[3]		
Service-sire fertility[1]	Low	Medium	High
Low	20.3	27.4	35.3
Medium	22.6	30.0	38.7
High	24.8	32.4	41.4
Difference[2]	4.5	5.0	6.1

[1] Low = service-sire SCR of ≤ – 0.9 %, medium = service-sire SCR of – 0.8 to 1.0 %, and high = service sire SCR of ≥ 1.1 %.
[2] High minus low.
[3] Low = herd conception rate of ≤ 27.3 %, medium = herd conception rate of 27.4 to 33.9 %, and high = herd conception rate of ≥ 34.0 %.

Herd Fertility

An additional study was completed to determine the relationship between bull SCR and the fertility level of herds for which the bull was service sire. Herd-years with ≥ 100 inseminations were stratified into 3 equally sized groups based on CR with approximately 6,900 herd-years in each group; CR limits were ≤ 27.3 %, 27.4 to 33.9 %, and ≥ 34.0 %. Similarly, bulls with ≥ 300 inseminations were stratified into 3 equally sized groups based on August 2008 SCR with approximately 570 bulls in each group; SCR limits were ≤ – 0.9 %, – 0.8 to 1.0 %, and ≥ 1.1 %. Herd CR for the 9 combinations of herd fertility and service-sire SCR are in Table 5. Herd CR were 4.5 percentage units higher (22 % superiority) for high-SCR bulls than for low-SCR bulls in low-fertility herds; corresponding difference for medium- and high-fertility herds were 5.0 percentage units (18 % superiority) and 6.1 percentage units (17 % superiority), respectively.

POTENTIAL BIAS

To address industry concerns on how a bull that was highly over evaluated or under evaluated for SCR would affect SCR of other bulls, all inseminations of a bull with an extremely high (11.3 %) January 2008 SCR based on 15,854 inseminations was excluded, and an alternate January 2008 SCR evaluation was computed. The correlation between SCR with and without the high-SCR bull was 0.999. Of the 2,166 bulls, 1,830 had exactly the same SCR. Of the remaining 336 bulls, SCR changed by 0.1 % for 322 bulls, 0.2 % for 12 bulls, and 0.3 and 0.5 % for the last 2 bulls. As a control, the same analysis was conducted with a bull with a more typical (1.3 %) January 2008 SCR based on 15,949 inseminations. The results were quite similar. Of the 2,166 bulls, 1,869 had exactly the same SCR. Of the remaining 297 bulls, 282 differed by 0.1 %, 14 differed by 0.2 %, and 1 differed by 0.3 %. Thus, most of the changes observed for other bulls, because of contemporaneous use with a potentially over evaluated bull, may have resulted simply from sampling and not from bias.

CONCLUSIONS

The new SCR evaluation is based on confirmed pregnancies and measures phenotypic service-sire fertility. It is expressed as a relative CR (an average bull has an SCR of 0.0 %). The standard deviation of SCR evaluations was 2.37 % in August 2008.

The first official SCR evaluations were released by USDA in August 2008 for active-AI and progeny-test bulls that met a minimum number of inseminations (300 for Holsteins). Data from over 80 % of the DHIA herds that collect breeding information are eligible for inclusion in the evaluation, and most states and Puerto Rico are represented for the 6 dairy breeds. Information from a larger number of inseminations is a primary reason for the higher accuracy of SCR compared with ERCR. Not only are more DHI herds included because many herds were added from the western U.S., but extra services (second through seventh) were included as well; which alone tripled the amount of data available.

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Reproductive records supplied by AgriTech Analytics, AgSource Cooperative Service, and DRMS were critical in the development of SCR. The willingness of U.S. dairy producers to record their management data is essential for continuation of an effective fertility evaluation for service sires. Suggestions provided by the National Association of Animal Breeders' Fertility Committee also were beneficial in the development of SCR.

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