A re-examination of service-sire conception rate in the United States

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Introduction

- Research initiated in 1986 at North Carolina Dairy Records Processing Center for predictions of service-sire fertility using DHIA data on 70-day nonreturn rate; called estimated relative conception rate (ERCR)
- USDA's Animal Improvement Programs Laboratory took over calculating ERCR in 2006; method revised by Dr. Melvin Kuhn in 2008 and labeled sire conception rate (SCR)
- Organizations relied more on SCR as breedings by AI technicians declined and on-farm service grew

Introduction *(continued)*

- Demand by producers for more reproductive assistance increased
  - Synchronized estrus flourished
  - Genetic traits introduced
    - Daughter pregnancy rate (DPR) in 2003
    - Cow conception rate (CCR) in 2009
    - Heifer conception rate (HCR) in 2009
  - SCR considered "phenotypic" because genetic component estimated to be only 0.1%

Introduction *(continued)*

- AI organizations that compensated dairy records processing centers (DRPCs) for breeding data had SCRs published for their bulls from 2008–14
- Council on Dairy Cattle Breeding (CDCB) agreed to pay these fees
- In April 2015, SCRs were published for bulls from all AI organizations if the bulls had the required number of herds (10 for Holsteins and Jerseys; 5 for other breeds) and number of services (300 for Holsteins; 200 for other breeds)

SCR model: Fixed effects

- Herd–year–season × registry status (2)
- Parity (5)
- Service number (7)
- Year–State–month
- Standardized milk yield level (6)
- Cow age grouping (7)
- Length of breeding interval (short) (2)

SCR model: Random effects

- Service bull's age group (up to 12, depending on breed)
- AI organization–mating year
- Service bull
- Cow (both permanent environment and genetic)
- Residual

SCR model: Covariances

- Inbreeding coefficient of service bull
- Inbreeding of embryo from mating

SCR prediction

- All effects are estimated each run from the latest 4 years of breeding data; desired effects are then used in a prediction model to produce the bull's SCR until the following calculation (4-month intervals)

- Some effects substituted back into the prediction model are different from the ones estimated; for example, the individual bulls are older each run so older age grouping effects are more appropriate

- Because more bulls are published, NAAB Sire Fertility Committee asked to review the procedure

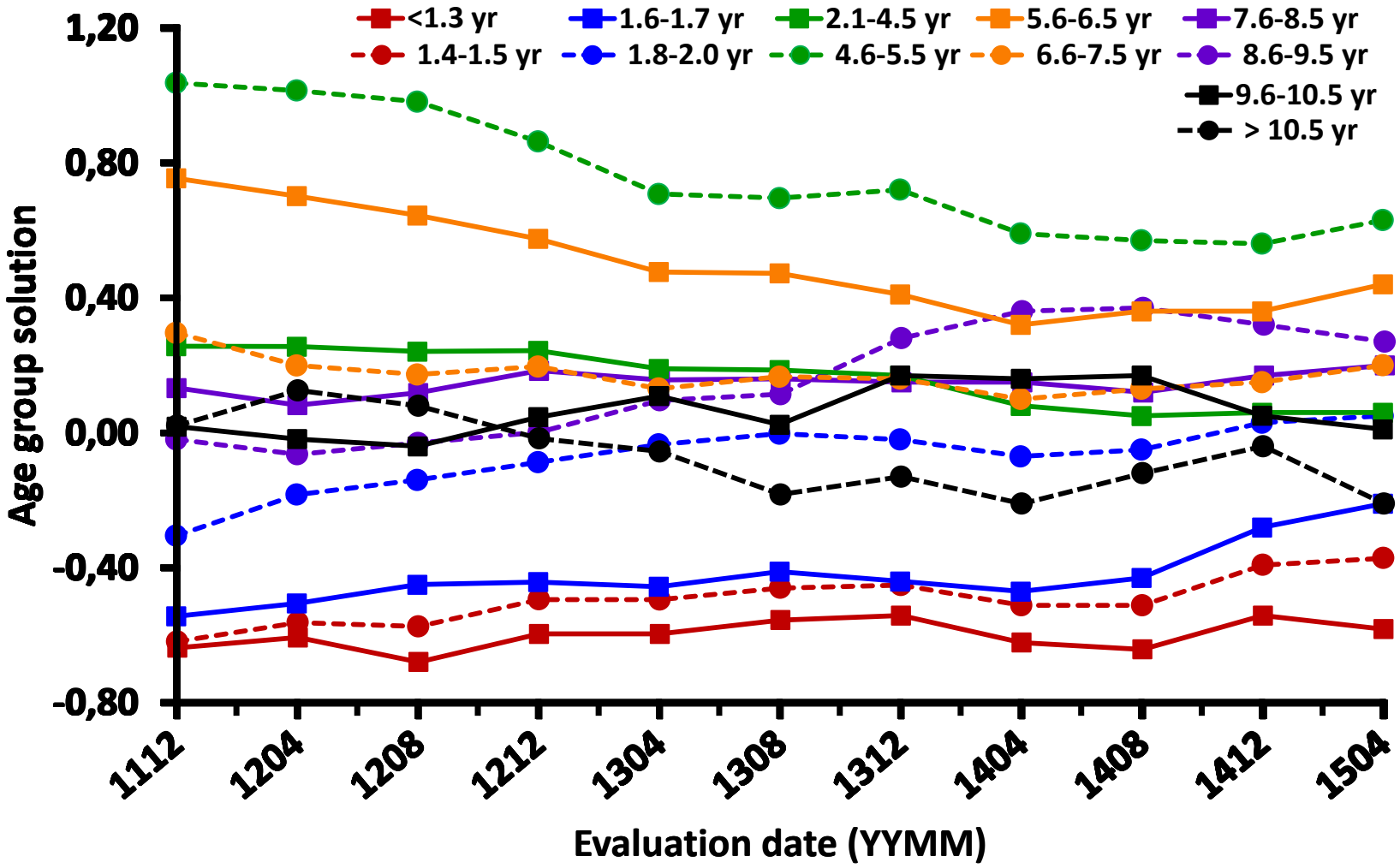
SCR prediction *(continued)*

- In 2008 we examined several effects in the model to make sure they were helpful; this included age grouping of bulls, AI organization–year, inbreeding coefficient of bull, and inbreeding coefficient of embryo
- The approach for determining helpful was to use alternative models, with and without each effect, and see how it impacted SCR ability to predict daughter conception after the cutoff date
- Daughter conception had only 2 outcomes: did she or did she not become pregnant?

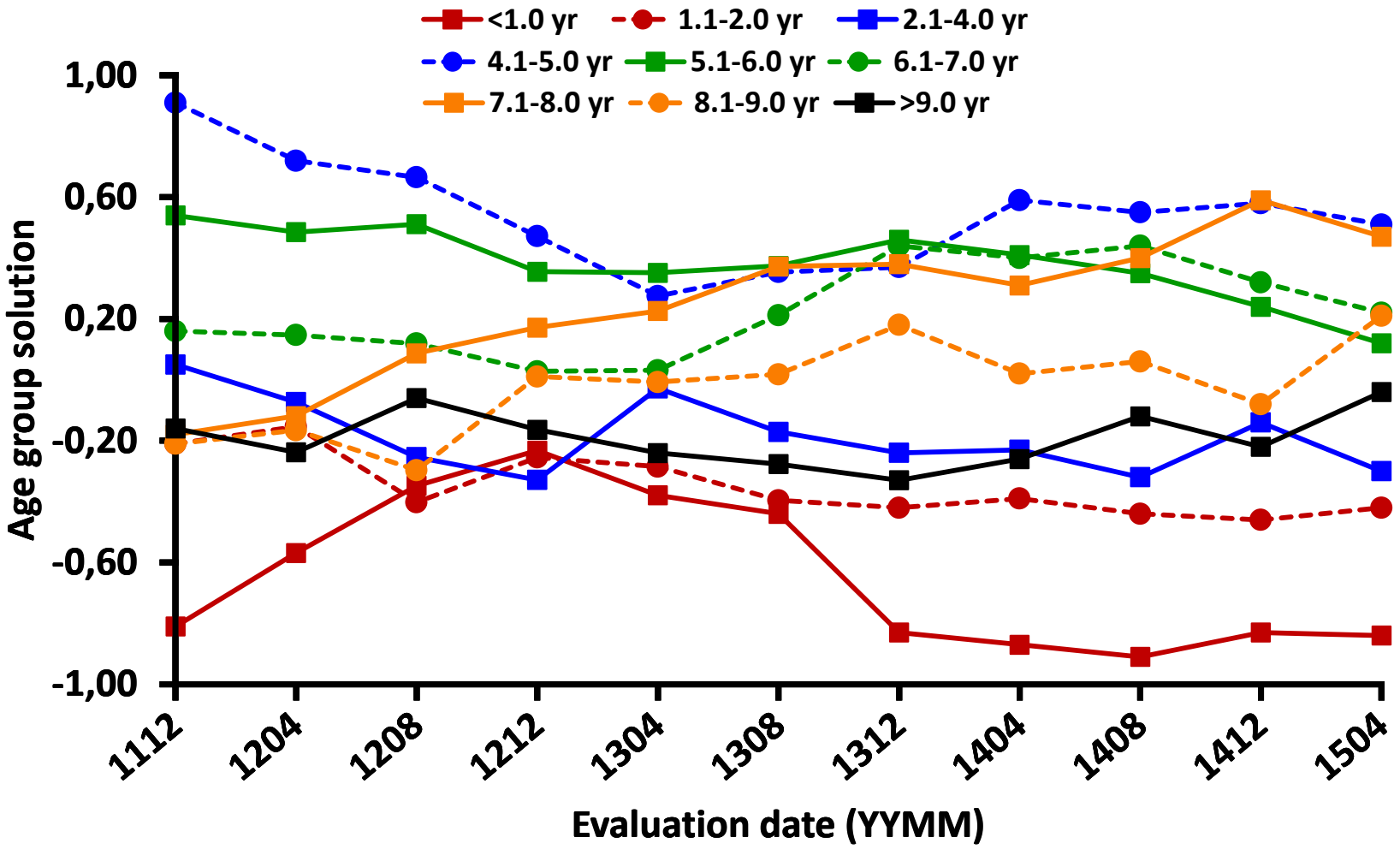
Objectives

- Re-examine effect of bull age (at time of mating) on CR
- Determine whether the age effects have changed over time
- Compare including effect for AI organization–mating year vs. including effect for mating year only
- Compare having separate effects for sampling group–mating year for AI organizations with multiple groups vs. an effect for AI organization–mating year only

SCR age solution groups – Holstein



SCR age solution groups – Jersey



Conception rates (CRs) and SCRs*

Breed	Services (no.)	Bulls with SCR (no.)	CR (%) Mean	CR (%) SD	Mean SCR
Holstein	>300	2,331	32.9	47.0	1.23
	>1,000	1,609	32.9	47.0	1.29
	>5,000	476	33.0	47.0	1.33
Jersey	>300	285	39.6	48.9	0.77

*Based on April 2014 evaluations; weighted by number of services

Correlations: Bull SCR with daughter CR in following year*

Breed	Services (no.)	Bulls with SCR (no.)	Correlation (r) With AI–year effect	Correlation (r) With year effect	Difference in r (%)
Holstein	>300	2,331	0.0221	0.0217	1.9
	>1,000	1,609	0.0215	0.0212	1.6
	>5,000	476	0.0230	0.0226	1.7
Jersey	>300	285	0.0300	0.0275	9.1

*Based on April 2014 evaluations; weighted by number of services

Holstein bulls combined or not combined

- Two AI organizations indicated they each operate with 2 NAAB codes, where processing and distributing semen might be similar; should they have separate AI organization–year effects? (This impacted NAAB code for 982 of 2,331 bulls)
- We consolidated these NAAB codes and examined outcome
  - Correlation between all bulls from original and alternate approaches was 0.999.
  - Correlations within 4 groups before vs. after combining ranged from 0.991 to 1.000 (impacted by number of bulls in each group and differences in AI organization–year effects)

Holstein bulls combined … *(continued)*

- We plan on taking it one more step and see which alternative did a better job of predicting CR after publication date

- This will help determine whether AI organizations should be combined if their semen collection and distribution methods are similar when managing multiple operations

Other changes being considered

- Reduce short interval from 10 to 7 days
  - First breeding excluded
  - Later breeding included

- Make gestation length specific to breed instead of 280 days (e.g., 282 for Ayrshires, 288 for Brown Swiss, 286 for Guernseys, 279 for Holsteins, 280 for Jerseys, 281 for Milking Shorthorns)

More changes considered

- Reduce the number of age groups in Jerseys to reduce sampling variation
- Consider alternative ways of setting the base; in spite of screening for fertility, currently all eligible service sires sum to 0, which means half are always negative

Conclusions

- CR is lowest for those bulls less than 1.3 years of age
- CR is highest when bulls are near 5 years of age
- Similar to previous results (7 years ago), prediction of CR is more accurate if AI organization–year effects are in the model than when only year effects are included

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