**Supplementary Table S1.** Heritability estimates (standard error in parenthesis) for the different fertility traits1 in Holstein cows.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AFS | AFC | | CFH | | CFS | | NS | | PFS | | Preg\_period | | | CIV | | CCI/DO | | FtL Insem | | NR | SR | | Parity2 | Population | | Reference |
|  |  | |  | |  | |  | |  | |  | | |  | | 0.03 | |  | |  |  | | M | US | | Abdallah and McDaniel (2000) |
|  |  | |  | | 0.02 | |  | |  | |  | | |  | | 0.044 | | 0.013 | | 0.02 |  | | 1 | Canada | | Bastin et al. (2010) |
|  |  | |  | |  | |  | |  | |  | | |  | | 0.05 (0.01) | |  | |  |  | | 1 | Belgium | | Bastin et al. (2012) |
|  | 0.07 | |  | | 0.07 (0.009) | | 0.03 (0.007) | | 0.01 (0.005) | | 0.03  (0.007) | | | 0.03  (0.005) | |  | |  | |  | 0.02 (0.006) | | 1 | Ireland | | Berry et al. (2013) |
|  |  | |  | | 0.04 (0.008) | | 0.04 (0.008) | | 0.01 (0.006) | | 0.04  (0.008) | | | 0.04  (0.006) | |  | |  | |  | 0.04 | | 2 | Ireland | | Berry et al. (2013) |
|  |  | |  | | 0.02 (0.008) | | 0.02 (0.01) | | 0.01 (0.007) | | 0.02  (0.008) | | |  | |  | | 0.01 (0.008) | |  |  | | M | Irish | | Berry et al. (2002) |
|  |  | | 0.16 (0.044) | | 0.11 (0.033) | | 0.07 (0.027) | | 0.03 (0.024) | |  | | | 0.05  (0.029) | |  | |  | |  |  | | 1 | Multiple | | Berry et al. (2012) |
|  |  | |  | | 0.05 (0.0025) | | 0.02 (0.0025) | | 0.04 (0.0025) | |  | | | 0.04  (0.0025) | | 0.04 (0.0025) | | 0.03 (0.0025) | |  |  | | M | Spain | | Gonzalez-Recio and Alenda (2005) |
|  | 0.19 (0.005) | |  | |  | |  | |  | |  | | |  | |  | |  | |  |  | | M | Iran | | Hadi Faraji-Arough et al (2011) |
|  |  | |  | |  | | 0.03 (0.01) | | 0.02 (0.01) | | 0.04  (0.01) | | |  | | 0.04 (0.02) | |  | |  | 0.06 (0.01) | | M | Australia | | Haile-Mariam et al. (2003) |
|  |  | |  | | 0.024 (0.003) | |  | |  | |  | | | 0.042  (0.003) | |  | |  | |  |  | | 1 | Australia | | Haile-Mariam et al. (2013) |
| 0.134 (0.013) |  | |  | |  | | 0.029 (0.006) | |  | |  | | |  | |  | | 0.03  (0.006) | | 0.029  (0.006) |  | | 1 | Canada | | Jamrozik et al. (2005) |
|  |  | |  | | 0.099 (0.01) | | 0.069 (0.01) | |  | |  | | |  | |  | | 0.07  (0.009) | | 0.04  (0.006) |  | | >1 | Canada | | Jamrozik et al. (2005) |
|  |  | |  | | 0.025 (0.005) | | 0.016 (0.005) | | 0.016 (0.004) | |  | | | 0.024  (0.006) | | 0.023 (0.005) | | 0.012 (0.004) | |  |  | | M | UK | | Kadarmideen et al. (2003) |
|  |  | |  | | 0.073 (0.006) | |  | |  | |  | | |  | |  | |  | | 0.029 (0.0004) |  | | M | Germany | | Konig et al. (2008) |
|  | 0.24 (0.02) | |  | |  | |  | |  | |  | | | 0.03  (0.01) | |  | |  | |  |  | | M | South Africa | | Makgahlela et al. (2007) |
|  |  | |  | | 0.05 (0.004) | | 0.04 (0.003) | | 0.02 (0.002) | |  | | | 0.04  (0.004) | |  | | 0.03 (0.003) | |  |  | | 1 | Sweden | | Mucha and Strandberg (2011) |
| CFH | | CFS | | NS | | PFS | | CIV | | CCI/DO | | FtL Insem | NR | | SR | | Parity | | Population | | | Reference | | |
|  | |  | |  | |  | | 0.04  (0.006) | |  | |  |  | |  | | 1 | | Ireland | | | Olori et al. (2002) | | |
|  | | 0.04 (0.01) | |  | |  | | 0.07  (0.013) | | 0.06 (0.008) | |  |  | |  | | M | | Iran | | | Pozveh et al. (2009) | | |
|  | |  | |  | |  | | 0.022  (0.005) | |  | |  |  | |  | | 1 | | UK | | | Pryce et al. (2000) | | |
|  | |  | |  | |  | | 0.025  (0.005) | |  | |  |  | |  | | M | | UK | | | Pryce et al. (2002) | | |
| 0.18 (0.03) | | 0.06 (0.02) | |  | |  | | 0.01  (0.02) | |  | |  |  | |  | | M | | UK | | | Pryce et al. 2001 | | |
|  | | 0.11 (0.05) | |  | | 0.14 (0.08) | |  | |  | |  |  | |  | | M | | UK | | | Royal et al. (2002) | | |
|  | | 0.07 (0.001) | |  | |  | |  | |  | | 0.049 (0.003) | 0.017  (0.003) | |  | | 1 | | Canada | | | Sewalem et al. (2010) | | |
|  | |  | |  | | 0.17 | |  | |  | |  | 0.011 | |  | | 1 | | Denmark | | | Sun and Su (2010) | | |
|  | |  | |  | | 0.048 | |  | |  | |  | 0.034 | |  | | 1 | | Denmark | | | Sun and Su (2010) | | |
|  | | 0.066 (0.003) | | 0.018 (0.001) | |  | |  | | 0.037 | |  | 0.01  (0.004) | |  | | M | | US | | | Van Raden et al. (2004) | | |
|  | | 0.07 (0.005) | | 0.034 (0.005) | | 0.016 (0.005) | | 0.036 (0.005) | |  | |  |  | |  | | 1 | | The Netherlands | | | Veerkamp et al. (2001) | | |
|  | | 0.035 (0.001) | | 0.02 (0.002) | |  | | 0.033 (0.001) | |  | |  | 0.018  (0.001) | |  | | 1 | | UK | | | Wall et al. (2003) | | |
|  | | 0.05 (0.01) | |  | |  | | 0.04 (0.01) | |  | |  | 0.014  (0.003) | |  | | M | | UK | | | Wall et al., 2005 | | |
|  | | 0.04 (0.01) | |  | |  | |  | | 0.04 (0.01) | | 0.03 (0.004) |  | |  | | 1 | | Czech | | | Zink et al. (2011) | | |
|  | | 0.04 (0.01) | |  | |  | |  | | 0.02 (0.01) | | 0.03 (0.01) |  | |  | | 2 | | Czech | | | Zink et al. (2011) | | |

**1AFS= age at first service; AFC = age at first calving; CFH=interval from calving to first heat; CFS = interval from calving to first service; NS = number of services; PFS = pregnant to first service; Preg\_period = pregnant over a given time period, CIV = calving interval; CCI/DO = calving to conception interval/days open; FtL Insem = interval from first to last service; NR = non-return; SR = Submission rate**

2M= multiple parities

**References.**

Abdallah JM, and McDaniel BT. 2000. Genetic parameters and trends of milk, fat, days open and body weight after calving in North Carolina Experimental Dairy Herds. Journal of Dairy Science. 83, 1364-1370.

Bastin C, Loker S, Gengler N, Sewalem A, and Miglior F. 2010. Genetic relationships between body condition score and reproduction traits in Canadian Holstein and Ayrshire first-parity cows. Journal of Dairy Science. 93, 2215-2228

Bastin C, Berry DP, Soyeurt H, and Gengler N. 2012. Genetic correlations of days open with production traits and contents in milk of major fatty acids predicted by mid-infrared spectrometry. Journal of Dairy Science. 95, 6113-6121

Berry DP, Bastiaansen JWM, Veerkamp RF, Wijga S, Wall E, Berglund B and Calus MPL 2012. Genome-wide associations for fertility traits in Holstein-Friesian dairy cows using data from experimental research herds in four European countries. Animal 6, 1206-1215

Berry DP, Buckley F, Dillon PG, Evans RD, Rath M and Veerkamp RF. 2002. Genetic parameters of level and change score, body weight, milk yield and fertility in dairy cows. Journal of Dairy Science 85, 2030-2039

Berry DP, Kearney JF, Twomey K and Evans RD. 2013. Genetics of reproductive performance in seasonal calving dairy cattle production systems. Irish Journal of Agricultural and Food Research 52: 1–16

González-Recio O, and Alenda R. 2005. Genetic parameters for female fertility traits and a fertility index in Spanish dairy cattle. Journal of Dairy Science. 88, 3282-3289

Faraji-Arough H, Asghar Aslaminejad A, and Farhangfar, H. 2011. Estimation of genetic parameters and trends for age at first calving and calving interval in Iranian Holstein cows. Journal of Research in Agricultural Science 7, 79-87

Haile-Mariam M, Morton JM, and Goddard ME. 2003. Estimates of genetic parameters for fertility traits of Australian Holstein-Friesian cattle. Animal Science. 76, 35-42.

Haile-Mariam M, Bowman PJ, and Pryce JE. 2013. Genetic analyses of fertility and predictor traits in Holstein herds with low and high mean calving intervals and in Jersey herds. Journal of Dairy Science. 96, 655-667

Jamrozik J, Fatehi J, Kistemaker GJ, and Schaeffer LR. 2005. Estimates of genetic parameters for Canadian Holstein female reproduction traits. Journal of Dairy Science. 88, 2199-2208

Kadarmideen HN, Thompson R, Coffey MP, and Kossaibati MA. 2003. Genetic parameters and evaluations from single- and multiple-trait analysis of dairy cow fertility and milk production Livestock Production Science. 81, 183-195

König S, Chang YM, Borstel UUV, Gianola D, and Simianer H. 2008. Genetic and phenotypic relationships among milk urea nitrogen, fertility, and milk yield in Holstein cows Journal of Dairy Science. 91, 4372-4382

Makgahlela ML, Banga CB, Norris D, Dzama K, and Ng’ambi JW. 2007. Genetic correlations between female fertility and production traits in South African Holstein cattle. South African Journal of Animal Science 37, 180-188.

Mucha S and Strandberg E. 2011 Genetic analysis of milk urea nitrogen and relationships with yield and fertility across lactation. Journal of Dairy Science 94, 5665-5672

Olori VE, Meuwissen THE, and Veerkamp RF. 2002. Calving interval and survival breeding values as measure of cow fertility in a pasture-based production system with seasonal calving. Journal of Dairy Science, 85, 689-696

Pozveh ST, Shadparvar AA, Shahrbabak MM, and Taromsari MD. 2009. Genetic analysis of reproduction traits and their relationship with conformation traits in Holstein cows Livestock Science, 125, 84-87

Pryce JE, Coffey MP and Brotherstone S. 2000. The genetic relationship between calving interval, body condition score and linear type and management traits in registered Holsteins. Journal of Dairy Science, 83, 2664-2671

Pryce JE, Coffey MP, Brotherstone S and Woolliams JA. 2002. Genetic relationships between calving interval and body condition score conditional on milk yield. Journal of Dairy Science. 85, 1590-1595

Pryce JE, Coffey MP and Simm G. 2001. The relationship between body condition score and reproductive performance. Journal of Dairy Science, 84, 1508-1515

Royal MD, Flint APF, and Woolliams JA. 2002. Genetic and phenotypic relationships among endocrine and traditional fertility traits and production traits in Holstein-Friesian dairy cows. Journal of Dairy Science. 85, 958-967

Sewalem A, Kistemaker GJ, and Miglior F. 2010. Relationship between female fertility and production traits in Canadian Holsteins. Journal of Dairy Science, 93, 4427-4434

Sun G, and Su G. 2010. Comparison on models for genetic evaluation of non-return rate and success in first insemination of the Danish Holstein cows. Livestock Science 127, 205–210

VanRaden PM, Sanders AH, Tooker ME, Miller RH, Norman HD, Kuhn MT, and Wiggans GR. 2004. Development of a national genetic evaluation for cow fertility. Journal of Dairy Science. 87, 2285-2292

Veerkamp RF, Koenen EPC, and De Jong G. 2001. Genetic correlations among body condition score, yield, and fertility in first-parity cows estimated by random regression models. Journal of Dairy Science 84, 2327-2335.

Wall E, Brotherstone S, Woolliams JA, Banos G, and Coffey MP 2003. Genetic evaluation of fertility using direct and correlated traits. Journal of Dairy Science 86, 4093-4102.

Wall E, White IMS, Coffey MP, and Brotherstone S. 2005. The relationship between fertility, rump angle, and selected type information in Holstein-Friesian cows. Journal of Dairy Science. 88, 1521-1528

Zink V, Štípková M, and Lassen J. 2011. Genetic parameters for female fertility, locomotion, body condition score, and linear type traits in Czech Holstein cattle Journal of Dairy Science. 94, 5176-5182