SEGES INNOVATION

STØTTET AF
Mælkeafgiftsfonden

Analysis of Calving traits

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Introduction

The calving index for a bull is a measure of the genetic potential of his offspring to have easy calvings (maternal effect). We use six traits to calculate this index:

1. Still birth, early
2. Calving ease, early
3. Calf size, early
4. Still birth, later
5. Calving ease, later
6. Calf size, later

Still birth is binary trait indicating whether a calf is stillborn. Calving ease and calf size are subjective judgements made by the farmers after birth. The traits are divided into early period

(birth from a heifer) and later period (birth from a cow), since births are usually easier later in a cows life.

For Holstein and RDC, we include information from foreign bulls via Interbull. This information is only for traits 1 and 2 (still birth, early and calving ease early).

For compactness of tables, we will use abbreviations throughout. They are mentioned here:

- ss: single-step breeding value
- rss: reduced information single-step breeding value
- ebv: tradition pedigree-based breeding value
- rebv: reduced information pedigree-based breeding value
- cor: correlation
- m_*: mean value of *
- s_*: standard deviation of *

Holstein

Genetic trends

Here, we exhibit the genetic trends of our evaluations for each trait. We see that the levels of breeding values are generally in agreement across evaluations.

Table 1: Genetic trends (Single-step (ss) vs new EBV (newebv) vs official EBV (offebv)) and correlation between single-step and official EBV for nordic AI bulls with at least 30 offspring in the full dataset

BYR	trait	n	m_ss	m_newebv	m_offebv	s_ss	s_newebv	s_offebv	cor
2009	nysb1	224	91.75	92.44	93.95	6.86	7.22	7.35	0.93
2010	nysb1	194	93.94	94.62	96.12	7.71	7.68	7.8	0.92
2011	nysb1	154	94.27	94.89	96.09	7.87	7.81	7.97	0.93
2012	nysb1	171	95.19	95.51	96.51	6.95	7.31	7.35	0.93
2013	nysb1	151	96.85	96.95	97.71	7.03	6.75	6.91	0.93
2014	nysb1	113	97.25	97.22	97.59	7.9	8.5	8.71	0.95
2015	nysb1	82	100.33	99.93	99.93	6.13	6.36	6.52	0.95
2016	nysb1	65	100.22	99.77	99.69	5.93	5.95	6.22	0.93
2017	nysb1	66	102.53	102.42	102.09	5.96	6.01	6.09	0.95
2018	nysb1	78	102.33	101.47	101.01	6.42	6.07	6.2	0.94
2019	nysb1	56	103.71	102.66	101.91	4.42	4.31	4.38	0.87
2020	nysb1	45	102.73	101.82	101.26	4.69	4.06	4.17	0.87
2009	nyce1	224	89.82	90.42	94.13	6.75	7.03	7.53	0.94
2010	nyce1	194	92.32	92.95	96.34	6.96	7.28	7.62	0.95
2011	nyce1	154	93.35	93.95	96.87	6.7	7.01	7.57	0.96
2012	nyce1	170	93.89	94.06	96.31	6.01	6.18	6.63	0.93

BYR	trait	n	m_ssm	m_newebv	m_offebv	s_ss	s_newebv	s_offebv	cor
2013	nyce1	151	95.94	96.11	97.77	5.34	5.63	6.19	0.93
2014	nyce1	111	97.52	97.85	98.74	6.52	6.93	7.5	0.96
2015	nyce1	82	99.91	99.87	100.09	4.66	5.25	5.6	0.95
2016	nyce1	65	101.02	100.65	100.69	4.84	5.03	5.28	0.95
2017	nyce1	66	103.79	103.55	103.05	5.31	5.25	5.4	0.96
2018	nyce1	78	103.44	102.95	102.13	4.73	4.82	4.85	0.94
2019	nyce1	56	103.96	103.02	101.94	3.98	4.21	4.38	0.92
2020	nyce1	45	104.89	103.8	102.84	3.72	3.14	3.35	0.92
2009	nycs1	159	94.57	94.86	93.74	10.98	10.5	10.33	0.96
2010	nycs1	144	95.09	95.42	94.46	10.28	10.32	10.31	0.97
2011	nycs1	114	95.33	96.0	95.18	11.52	11.71	11.67	0.97
2012	nycs1	137	94.68	94.47	93.77	9.05	8.88	8.82	0.95
2013	nycs1	113	95.66	96.17	95.65	10.4	10.42	10.37	0.97
2014	nycs1	100	97.96	98.24	98.03	9.49	9.84	9.77	0.96
2015	nycs1	78	97.64	97.92	97.9	8.16	8.88	8.8	0.97
2016	nycs1	62	95.69	96.16	96.35	9.86	9.91	9.82	0.98
2017	nycs1	65	99.03	99.26	99.67	8.32	8.38	8.33	0.96
2018	nycs1	75	98.41	98.35	98.87	7.93	7.39	7.29	0.93
2019	nycs1	52	101.35	100.62	101.31	8.86	8.7	8.63	0.92
2020	nycs1	41	99.44	99.24	99.91	8.13	8.25	8.04	0.96
2009	nysb2	224	94.16	94.33	94.07	7.53	7.88	7.65	0.92
2010	nysb2	194	93.89	94.04	93.61	7.38	7.65	7.54	0.92
2011	nysb2	155	95.96	95.68	95.31	7.96	8.28	8.07	0.95
2012	nysb2	171	96.45	96.28	95.69	6.98	7.21	7.02	0.92
2013	nysb2	151	96.45	95.93	95.31	7.51	7.61	7.46	0.93
2014	nysb2	113	99.59	99.09	98.44	7.07	7.4	7.19	0.95
2015	nysb2	83	100.7	100.1	99.48	6.86	7.52	7.31	0.96
2016	nysb2	65	101.69	100.86	100.1	5.63	6.45	6.37	0.92
2017	nysb2	66	104.23	103.58	102.93	5.92	6.43	6.36	0.96
2018	nysb2	78	103.91	103.46	102.72	6.0	5.42	5.35	0.88
2019	nysb2	51	103.9	102.51	102.0	6.1	6.01	5.86	0.87
2020	nysb2	11	103.91	103.18	102.67	6.66	4.51	3.95	0.88
2009	nyce2	223	93.33	93.68	94.24	7.6	8.36	8.01	0.96

BYR	trait	n	m_ssm_newebv	m_offebv	s_ss	s_newebv	s_offebv	cor
2010	nyce2	194	94.01	94.2	94.63	7.47	8.08	7.81	0.94
2011	nyce2	155	95.81	96.22	96.42	7.2	7.64	7.34	0.97
2012	nyce2	171	95.89	96.26	96.24	5.56	6.04	5.81	0.94
2013	nyce2	151	96.72	96.48	96.41	6.1	6.87	6.67	0.95
2014	nyce2	113	99.48	99.78	99.54	6.22	6.72	6.53	0.97
2015	nyce2	83	100.48	100.59	100.35	5.02	5.37	5.22	0.96
2016	nyce2	65	101.17	101.17	100.8	4.83	5.24	5.19	0.94
2017	nyce2	66	103.89	103.77	103.38	4.1	4.46	4.31	0.91
2018	nyce2	78	103.85	103.59	103.2	4.34	4.76	4.51	0.89
2019	nyce2	48	102.71	102.31	101.98	5.16	5.32	5.28	0.92
2009	nycs2	158	93.6	94.78	93.09	10.74	10.97	10.77	0.97
2010	nycs2	144	92.86	93.92	92.49	10.03	9.96	9.79	0.97
2011	nycs2	114	93.75	94.76	93.53	10.48	10.53	10.37	0.98
2012	nycs2	137	94.54	94.74	93.73	9.2	9.21	9.21	0.97
2013	nycs2	114	95.47	95.77	95.12	9.93	9.79	9.71	0.97
2014	nycs2	104	96.28	96.54	96.12	8.88	9.1	9.0	0.97
2015	nycs2	78	97.68	97.79	97.73	8.71	8.73	8.64	0.98
2016	nycs2	62	95.92	96.13	96.26	9.12	8.77	8.68	0.97
2017	nycs2	65	99.68	99.32	99.75	7.25	7.6	7.47	0.97
2018	nycs2	75	98.75	98.11	98.81	7.9	7.73	7.65	0.93
2019	nycs2	45	100.04	99.47	100.42	9.5	9.38	9.38	0.95

Table 2: Genetic trends (Single-step full dataset (f) vs single-step reduced dataset (r)) for nordic AI bulls with at least 30 offspring in the full dataset

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2009	nysb1	224	93.7	93.77	7.12	7.31	0.68	0.99
2010	nysb1	194	95.94	96.26	8.02	8.2	0.72	0.99
2011	nysb1	154	96.32	96.6	8.1	8.42	0.64	0.99
2012	nysb1	171	97.23	97.66	7.26	7.37	0.82	0.99
2013	nysb1	151	98.94	99.41	7.32	7.49	0.88	0.99
2014	nysb1	113	99.32	99.67	8.28	8.56	1.01	0.99
2015	nysb1	82	102.61	103.6	6.4	6.79	1.16	0.99
2016	nysb1	65	102.49	103.15	6.29	6.62	2.82	0.83
2017	nysb1	66	105.0	104.8	6.28	7.21	2.74	0.86

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2018	nysb1	78	104.71	105.42	6.67	6.55	3.54	0.79
2019	nysb1	56	106.23	107.21	4.66	5.78	3.59	0.68
2020	nysb1	45	105.18	106.71	4.9	5.96	3.18	0.79
2009	nyce1	224	93.2	93.24	7.28	7.31	0.59	0.99
2010	nyce1	194	95.85	96.09	7.61	7.7	0.8	0.99
2011	nyce1	154	97.01	97.11	7.27	7.35	0.68	0.99
2012	nyce1	170	97.62	97.92	6.5	6.65	0.81	0.99
2013	nyce1	151	99.8	100.25	5.81	6.06	0.89	0.98
2014	nyce1	111	101.55	101.74	7.07	7.41	0.73	0.99
2015	nyce1	82	104.1	104.87	5.02	5.3	0.89	0.98
2016	nyce1	65	105.32	105.92	5.37	6.94	3.68	0.77
2017	nyce1	66	108.33	108.48	5.75	7.59	3.03	0.84
2018	nyce1	78	107.97	108.23	5.1	6.63	3.67	0.74
2019	nyce1	56	108.57	109.5	4.28	7.38	4.64	0.55
2020	nyce1	45	109.47	110.31	4.05	6.2	3.11	0.8
2009	nycs1	159	93.9	93.84	11.1	11.05	1.21	0.99
2010	nycs1	144	94.47	94.39	10.41	10.48	1.37	0.98
2011	nycs1	114	94.7	94.51	11.64	12.08	1.21	0.99
2012	nycs1	137	94.01	94.0	9.11	9.19	1.23	0.98
2013	nycs1	113	95.06	95.48	10.5	10.67	1.23	0.99
2014	nycs1	100	97.34	97.54	9.55	9.49	1.54	0.97
2015	nycs1	78	96.99	98.29	8.24	8.57	1.92	0.97
2016	nycs1	62	95.03	95.68	9.94	8.43	5.03	0.75
2017	nycs1	65	98.43	99.98	8.27	7.82	5.4	0.67
2018	nycs1	75	97.85	99.11	7.99	7.78	5.87	0.61
2019	nycs1	52	100.77	103.46	8.91	7.72	5.5	0.69
2020	nycs1	41	98.8	100.76	8.12	6.45	5.76	0.57
2009	nysb2	224	94.29	94.75	7.77	7.9	1.06	0.99
2010	nysb2	194	94.02	94.89	7.64	7.91	1.3	0.98
2011	nysb2	155	96.19	96.97	8.29	8.56	1.32	0.98
2012	nysb2	171	96.65	97.51	7.2	7.6	1.46	0.98
2013	nysb2	151	96.64	97.56	7.74	8.12	1.35	0.98
2014	nysb2	113	99.89	100.89	7.35	7.75	1.64	0.97

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2015	nysb2	83	101.02	102.71	7.15	7.56	1.93	0.97
2016	nysb2	65	101.98	103.74	5.72	6.61	5.51	0.41
2017	nysb2	66	104.73	105.29	6.18	6.47	5.17	0.48
2018	nysb2	78	104.33	104.86	6.24	7.13	4.24	0.67
2019	nysb2	51	104.43	106.57	6.26	6.84	5.2	0.59
2020	nysb2	11	104.09	105.0	6.88	5.59	4.91	0.46
2009	nyce2	223	94.01	94.09	7.53	7.53	0.7	0.99
2010	nyce2	194	94.62	94.88	7.34	7.49	0.81	0.99
2011	nyce2	155	96.44	96.68	7.13	7.24	0.83	0.99
2012	nyce2	171	96.49	96.92	5.52	5.68	0.78	0.98
2013	nyce2	151	97.35	97.75	5.97	6.1	1.03	0.98
2014	nyce2	113	100.18	100.58	6.14	6.43	0.94	0.98
2015	nyce2	83	101.04	101.77	4.97	5.32	1.14	0.97
2016	nyce2	65	101.74	102.28	4.68	6.48	4.48	0.52
2017	nyce2	66	104.47	104.65	4.06	6.66	4.55	0.56
2018	nyce2	78	104.37	104.31	4.36	5.88	4.6	0.41
2019	nyce2	48	103.19	103.94	5.03	6.91	5.21	0.5
2009	nycs2	158	92.89	92.97	10.72	10.83	0.73	1.0
2010	nycs2	144	92.22	92.24	9.98	10.14	0.9	0.99
2011	nycs2	114	93.0	93.16	10.47	10.5	0.74	0.99
2012	nycs2	137	93.83	93.91	9.12	9.25	0.89	0.99
2013	nycs2	114	94.86	94.72	9.91	9.99	1.05	0.99
2014	nycs2	104	95.58	95.7	8.85	9.21	1.22	0.98
2015	nycs2	78	96.99	98.0	8.63	8.65	1.27	0.99
2016	nycs2	62	95.23	95.79	9.14	8.53	4.56	0.78
2017	nycs2	65	98.98	100.15	7.23	6.85	4.98	0.59
2018	nycs2	75	98.03	98.64	7.9	7.43	5.36	0.64
2019	nycs2	45	99.47	101.33	9.46	7.37	5.64	0.68

Table 3: Genetic trends (Single-step full dataset (f) vs single-step reduced dataset (r)) for nordic cows with genotype and phenotype

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2009	nysb1	1075	90.94	91.03	7.5	7.69	1.11	0.98
2010	nysb1	1515	91.85	91.82	7.89	8.09	1.1	0.98

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2011	nysb1	2992	92.93	92.97	7.41	7.62	1.08	0.98
2012	nysb1	4532	93.79	93.83	7.6	7.86	1.11	0.98
2013	nysb1	7532	95.81	95.96	7.33	7.54	1.14	0.98
2014	nysb1	8753	95.73	95.9	7.24	7.5	1.16	0.98
2015	nysb1	10672	96.79	97.01	6.9	7.15	1.2	0.98
2016	nysb1	15819	97.97	98.29	6.84	7.1	1.24	0.97
2017	nysb1	22793	99.08	99.54	6.83	7.14	1.28	0.97
2018	nysb1	32119	100.52	101.07	6.66	6.68	1.68	0.95
2019	nysb1	35324	101.34	101.72	6.44	6.63	2.03	0.92
2020	nysb1	40916	102.75	103.58	6.22	6.5	2.23	0.91
2021	nysb1	42445	103.15	104.01	6.18	6.84	2.73	0.88
2022	nysb1	45302	104.21	105.75	5.89	6.56	2.72	0.88
2023	nysb1	20530	104.47	105.98	5.99	6.58	2.68	0.88
2009	nyce1	1037	89.02	88.92	7.07	7.34	1.39	0.97
2010	nyce1	1414	90.31	90.21	7.35	7.68	1.34	0.97
2011	nyce1	2704	91.24	91.13	7.14	7.47	1.35	0.97
2012	nyce1	4000	92.2	92.06	7.2	7.57	1.4	0.97
2013	nyce1	6656	93.8	93.73	6.91	7.26	1.38	0.97
2014	nyce1	7920	95.01	94.96	6.88	7.25	1.42	0.97
2015	nyce1	9660	96.21	96.27	6.76	7.1	1.42	0.97
2016	nyce1	14507	97.7	97.81	6.68	7.08	1.5	0.96
2017	nyce1	20375	99.25	99.4	6.53	6.98	1.5	0.96
2018	nyce1	28546	100.68	101.14	6.29	6.66	1.86	0.93
2019	nyce1	31467	102.54	102.73	6.2	6.76	2.38	0.89
2020	nyce1	36056	103.96	104.47	6.03	6.83	2.41	0.89
2021	nyce1	36760	104.99	106.03	5.81	7.18	3.07	0.84
2022	nyce1	39733	106.04	108.06	5.65	7.08	3.46	0.83
2023	nyce1	18054	106.71	108.74	5.63	6.81	3.24	0.85
2009	nycs1	763	94.34	93.81	8.73	8.68	2.17	0.95
2010	nycs1	950	93.39	93.08	9.1	9.15	2.24	0.95
2011	nycs1	1432	93.64	93.35	9.31	9.37	2.15	0.96
2012	nycs1	2079	94.67	94.6	8.95	8.99	2.23	0.95
2013	nycs1	3468	95.77	95.63	8.82	8.79	2.23	0.95

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2014	nycs1	3993	95.5	95.46	8.71	8.71	2.25	0.95
2015	nycs1	4878	96.49	96.61	8.27	8.32	2.26	0.94
2016	nycs1	7662	96.44	96.82	8.74	8.74	2.39	0.94
2017	nycs1	10844	97.48	98.23	8.15	8.19	2.51	0.93
2018	nycs1	16149	96.38	97.58	8.19	7.81	2.98	0.9
2019	nycs1	17788	97.67	99.54	8.08	7.88	3.95	0.83
2020	nycs1	19936	98.44	99.88	8.02	7.77	4.16	0.8
2021	nycs1	19767	99.21	100.63	7.83	7.49	4.58	0.74
2022	nycs1	21736	100.53	101.02	7.79	7.27	4.14	0.77
2023	nycs1	11430	99.97	101.01	7.69	7.12	4.24	0.75
2009	nysb2	1009	90.11	90.28	7.03	7.33	1.59	0.96
2010	nysb2	1391	89.47	89.6	7.7	8.1	1.65	0.97
2011	nysb2	2592	91.48	91.69	7.35	7.8	1.64	0.96
2012	nysb2	3896	93.04	93.32	7.14	7.65	1.69	0.96
2013	nysb2	6189	93.5	93.86	7.05	7.49	1.7	0.96
2014	nysb2	6998	94.53	95.0	6.78	7.19	1.74	0.95
2015	nysb2	8487	95.29	95.92	6.77	7.19	1.83	0.95
2016	nysb2	12548	96.41	97.24	6.82	7.31	1.94	0.95
2017	nysb2	18073	97.92	98.88	6.66	7.16	2.0	0.94
2018	nysb2	24012	99.44	100.51	6.62	6.98	2.53	0.9
2019	nysb2	25546	100.59	101.45	6.61	6.74	3.24	0.82
2020	nysb2	28314	101.59	102.81	6.49	6.82	3.19	0.83
2021	nysb2	25773	101.83	103.6	6.46	7.14	3.55	0.82
2022	nysb2	9307	102.18	104.87	6.64	7.14	3.97	0.82
2009	nyce2	979	90.03	89.91	6.69	6.96	1.43	0.96
2010	nyce2	1292	89.74	89.7	6.71	7.07	1.39	0.97
2011	nyce2	2361	91.23	91.23	6.82	7.11	1.43	0.97
2012	nyce2	3537	92.6	92.54	6.53	6.87	1.46	0.96
2013	nyce2	5702	93.13	93.09	6.42	6.76	1.45	0.96
2014	nyce2	6352	94.56	94.62	6.22	6.57	1.5	0.96
2015	nyce2	7809	95.27	95.38	6.11	6.47	1.51	0.95
2016	nyce2	11710	96.35	96.61	6.07	6.47	1.59	0.95
2017	nyce2	16375	97.25	97.59	5.75	6.14	1.61	0.94

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2018	nyce2	21624	98.46	99.0	5.65	6.19	2.05	0.9
2019	nyce2	22884	100.07	100.18	5.54	6.11	2.72	0.83
2020	nyce2	25053	100.4	101.12	5.43	6.24	2.83	0.83
2021	nyce2	22328	101.5	102.4	5.38	6.32	2.91	0.82
2022	nyce2	8141	101.81	103.46	5.27	6.34	3.27	0.8
2009	nycs2	731	93.62	93.34	8.41	8.34	1.54	0.97
2010	nycs2	872	92.55	92.55	9.06	9.16	1.59	0.97
2011	nycs2	1268	93.37	93.34	8.86	8.98	1.64	0.97
2012	nycs2	1840	93.86	93.97	8.62	8.71	1.7	0.97
2013	nycs2	2955	94.82	94.85	8.37	8.45	1.67	0.97
2014	nycs2	3167	94.68	94.72	8.44	8.49	1.75	0.97
2015	nycs2	3861	96.27	96.37	8.04	8.17	1.77	0.96
2016	nycs2	5990	95.91	96.04	8.16	8.19	1.8	0.96
2017	nycs2	8642	96.95	97.3	7.88	7.93	1.86	0.96
2018	nycs2	11682	96.84	97.31	8.15	7.81	2.47	0.92
2019	nycs2	12093	97.36	98.68	7.64	7.33	3.38	0.85
2020	nycs2	12483	98.99	99.53	7.31	7.14	3.51	0.82
2021	nycs2	10891	99.3	100.07	7.66	7.3	4.2	0.77
2022	nycs2	4445	100.17	100.06	7.87	6.96	4.36	0.75

Test of Foreign information

As part of the Interbull collaboration, we recieve breeding values from foreign (non-nordic) bulls, along with a reliability. These has to be converted to a pseudo-phenotype to be included in the evaluation. Here, we test that the calculated breeding values for these bulls are similar to the original ones from Interbull in mean and standard deviation.

Table 4: Means and standard deviations for foreign bulls in new single-step (ss), new EBV (ebv) and original interbull breeding value (bv), as well as correlation between single-step breeding value and Interbull breeding value. Still birth first lactation.

BYR	n	m_ss	m_ebv	m_bv	s_ss	s_ebv	s_bv	cor_ss	cor_ebv
2009	1016	87.8	88.54	90.07	11.15	11.79	9.32	0.92	0.97
2010	1156	87.3	88.03	89.49	11.11	11.74	9.84	0.92	0.97
2011	1052	89.85	90.71	91.39	11.11	11.71	9.51	0.91	0.96
2012	1052	90.98	91.59	91.86	10.68	10.9	9.27	0.91	0.96
2013	797	93.1	93.52	93.44	10.16	10.67	9.1	0.9	0.96
2014	610	95.42	96.34	95.4	8.94	8.92	7.91	0.89	0.95

BYR	n	m_ss	m_ebv	m_bv	s_ss	s_ebv	s_bv	cor_ss	cor_ebv
2015	481	97.78	99.03	97.06	8.88	9.04	8.23	0.89	0.95
2016	455	98.19	99.0	96.97	9.63	9.59	8.92	0.9	0.96
2017	413	102.07	103.41	100.52	7.99	7.89	7.14	0.86	0.94
2018	330	101.44	102.47	99.96	8.81	8.68	8.45	0.88	0.96
2019	315	103.42	105.12	101.76	7.61	7.31	6.95	0.84	0.96
2020	94	104.67	105.45	101.53	7.55	6.69	6.4	0.87	0.96

Table 5: Means and standard deviations for foreign bulls in new single-step (ss), new EBV (ebv) and original interbull breeding value (bv), as well as correlation between single-step breeding value and Interbull breeding value. Calving ease first lactation.

BYR	n	m_ss	m_ebv	m_bv	s_ss	s_ebv	s_bv	cor_ss	cor_ebv
2009	767	88.2	89.1	92.09	9.51	10.84	7.48	0.89	0.97
2010	915	89.97	91.07	92.6	9.52	10.51	7.46	0.88	0.96
2011	847	93.02	94.16	94.44	9.47	10.51	7.43	0.89	0.95
2012	809	95.16	95.83	95.33	9.18	9.93	7.16	0.86	0.95
2013	648	97.62	98.4	96.71	9.17	10.68	7.62	0.88	0.96
2014	510	99.47	100.78	98.09	9.33	10.24	7.43	0.89	0.96
2015	380	102.07	103.22	99.33	8.52	9.57	7.26	0.87	0.95
2016	371	104.81	106.19	100.98	8.61	9.86	7.02	0.87	0.95
2017	340	108.09	109.84	103.25	8.0	8.63	6.35	0.84	0.94
2018	280	109.51	111.68	104.72	8.94	10.26	7.45	0.88	0.97
2019	262	109.97	112.51	104.88	8.56	10.39	7.67	0.9	0.97
2020	72	109.57	111.17	103.9	7.6	9.07	5.99	0.85	0.96

Correlations

Here, we give correlation tables and tables of differences between the relevant evaluations. We test that we didn't change the model by comparing our new model without genomic information to the breeding values of the traditional pedigree-based model and expect very high correlations for tested animals. We test the change by incorporating genomic information, compared to a non-genomic evaluation, and expect to see some changes even in tested animals, but not too large.

Table 6: Correlations between current EBV and new EBV for Nordic AI bulls with > 30 offspring in nysb1

BYR	n	cor7	cor8	cor9	cor10	cor11	cor12
2009	224	0.992	0.99	0.998	0.993	0.997	0.999
2010	194	0.994	0.992	0.999	0.996	0.998	0.999

BYR	n	cor7	cor8	cor9	cor10	cor11	cor12
2011	154	0.996	0.995	0.999	0.997	0.997	0.999
2012	171	0.997	0.991	0.999	0.996	0.996	0.999
2013	151	0.994	0.982	0.999	0.995	0.995	0.998
2014	113	0.994	0.99	0.999	0.996	0.997	0.999
2015	82	0.996	0.991	0.999	0.996	0.995	0.999
2016	65	0.997	0.989	0.999	0.995	0.996	0.998
2017	66	0.994	0.99	0.999	0.995	0.994	0.998
2018	78	0.997	0.982	0.998	0.993	0.992	0.998
2019	56	0.993	0.985	0.999	0.996	0.995	0.998
2020	45	0.997	0.982	0.999	0.988	0.981	0.998

Table 7: Table of differences between current EBV and new EBV for Nordic AI bulls with > 30 offspring in nysb1 born after 2015

dif	dif7	dif8	dif9	dif10	dif11	dif12
−4.0	1	3	0	0	0	0
−3.0	0	5	0	2	2	0
−2.0	7	38	0	33	9	1
−1.0	129	133	9	150	117	10
0.0	172	116	160	129	181	141
1.0	9	20	146	5	9	159
2.0	1	4	4	0	1	8

Table 8: Correlations between current EBV and new Single-step for AI bulls with > 30 offspring in nysb1

BYR	n	cor7	cor8	cor9	cor10	cor11	cor12
2009	224	0.928	0.937	0.909	0.923	0.955	0.935
2010	194	0.921	0.946	0.923	0.92	0.942	0.933
2011	154	0.934	0.958	0.936	0.952	0.967	0.936
2012	171	0.935	0.933	0.906	0.921	0.937	0.928
2013	151	0.928	0.929	0.939	0.926	0.946	0.936
2014	113	0.948	0.953	0.934	0.95	0.966	0.928
2015	82	0.95	0.952	0.963	0.964	0.965	0.974
2016	65	0.932	0.95	0.98	0.922	0.936	0.962
2017	66	0.949	0.962	0.957	0.955	0.911	0.965
2018	78	0.936	0.941	0.923	0.88	0.887	0.926

BYR	n	cor7	cor8	cor9	cor10	cor11	cor12
2019	56	0.871	0.919	0.914	0.862	0.909	0.909
2020	45	0.872	0.921	0.953	0.829	0.79	0.899

Table 9: Table of differences between current EBV and new Single-step for AI bulls with > 30 offspring in nysb1 born after 2015

dif	dif7	dif8	dif9	dif10	dif11	dif12
−15.0	0	0	1	0	0	0
−14.0	0	0	0	0	0	0
−13.0	0	0	0	0	0	0
−12.0	0	0	0	0	0	1
−11.0	0	0	0	0	0	1
−10.0	0	0	1	3	0	1
−9.0	1	0	1	3	0	0
−8.0	0	0	1	5	0	2
−7.0	4	1	2	9	1	1
−6.0	7	1	3	11	6	3
−5.0	12	9	2	20	11	11
−4.0	13	17	8	20	19	15
−3.0	40	40	10	27	14	14
−2.0	51	64	21	33	30	21
−1.0	67	91	36	59	63	38
0.0	66	51	82	64	95	68
1.0	33	31	65	39	42	59
2.0	11	7	27	13	21	29
3.0	8	2	23	8	7	21
4.0	1	3	12	3	7	9
5.0	2	2	9	1	2	12
6.0	1	0	8	0	1	4
7.0	0	0	5	0	0	3
8.0	1	0	0	0	0	3
9.0	0	0	0	0	0	3
10.0	1	0	2	1	0	0

Table 10: Correlations between current two-step and new Single-step (combined calving index) for genotyped AI bulls born after 2009 with > 30 offspring

BYR	n	cor
2009	223	0.932
2010	193	0.953
2011	154	0.933
2012	171	0.955
2013	151	0.93
2014	113	0.968
2015	82	0.96
2016	65	0.946
2017	66	0.953
2018	78	0.947
2019	56	0.895
2020	45	0.799

Table 11: Table of differences between current two-step and new Single-step (combined calving index) for genotyped AI bulls with > 30 offspring born after 2015

dif	dif14
−7.0	1
−6.0	1
−5.0	4
−4.0	17
−3.0	20
−2.0	46
−1.0	63
0.0	72
1.0	49
2.0	26
3.0	9
4.0	4
5.0	3
6.0	3
7.0	0
8.0	1

Table 12: Correlations between current two-step and new Single-step for genotyped nordic bulls with no offspring born after 2020

BYR	n	cor
2020	3123	0.862
2021	3153	0.849
2022	3270	0.842
2023	3079	0.81
2024	3001	0.818
2025	1276	0.837

Table 13: Table of differences between current two-step and new Single-step for genotyped nordic bulls born after 2020 with no offspring

dif	dif14
−14.0	3
−13.0	2
−12.0	5
−11.0	13
−10.0	32
−9.0	79
−8.0	160
−7.0	272
−6.0	498
−5.0	750
−4.0	1064
−3.0	1327
−2.0	1608
−1.0	1707
0.0	1666
1.0	1524
2.0	1159
3.0	885
4.0	539
5.0	345
6.0	193
7.0	94
8.0	55
9.0	23

dif	dif14
10.0	9
11.0	4
12.0	3
13.0	1
14.0	2
15.0	1

Legarra-Reverter test

The Legarra-Reverter test is a test for bias in evaluations. We perform two calculations of breeding values, one with all information available and one where offspring of sires born after 2018 has their records removed. Then we perform a linear regression on genotyped, nordic bulls, who has no data in the reduced dataset and with more than 30 offspring in the full dataset. We also require that their sires are not in the focal group, so we remove bulls whose father meets the same criteria.

The slope of the regression indicates the bias, with a slope of one meaning no bias, a slope less than one indicating that the estimated values of unproven animals are too extreme, and a slope higher than one indicating that the estimated breeding values of unproven animals are too conservative.

As can be seen, we have some issues with the Legarra-Reverter test. We're looking into it.

Table 14: Legarra-Reverter scores
Singlestep:

trait	b1	rsquare	n
nysb1	0.742	0.656	312
nyce1	0.549	0.584	311
nycs1	0.774	0.484	290
nysb2	0.491	0.293	266
nyce2	0.364	0.258	262
nycs2	0.751	0.474	248

EBV:

trait	b1	rsquare	n
nysb1	0.771	0.358	312
nyce1	0.579	0.335	311
nycs1	0.742	0.213	290
nysb2	0.489	0.126	266
nyce2	0.329	0.075	262

trait	b1	rsquare	n
nycs2	0.732	0.191	248

Mendelian sampling

The mendelian sampling of an animals is its deviation of its breeding values from the expected breeding value, which is the average of its parents breeding values. Some mendelian samling is expected on the individual level (this is what enables breeding), but across all animals we expect it to be close to zero. Otherwise, this indicates a bias in the set of animals in the evaluation, which violates the unbiasedness of the BLUP model. We conclude that the mendelian sampling is generally close to 0.

Table 15: Average mendelian sampling by birth year. Animals are only included if they are genotyped, their sire has > 30 offspring in nysb1 and their dam is genotyped.

BYR	m7	m8	m9	m10	m11	m12
2010	−0.534	−0.232	−0.038	−0.364	0.081	−0.418
2011	−0.355	−0.184	0.016	−0.397	−0.099	−0.107
2012	0.267	0.157	0.068	0.283	0.162	−0.043
2013	0.347	0.34	0.064	0.469	0.371	0.1
2014	0.261	0.251	0.171	0.258	0.239	0.278
2015	0.24	0.125	0.167	0.22	0.16	0.176
2016	0.176	−0.018	0.144	0.139	−0.075	0.15
2017	0.061	−0.06	0.075	0.014	−0.107	0.119
2018	0.18	0.033	0.091	0.184	−0.05	0.117
2019	0.054	0.009	−0.043	0.14	0.086	0.132
2020	0.275	0.152	0.124	0.359	0.156	0.181
2021	0.237	0.228	0.14	0.307	0.126	0.149
2022	0.145	0.083	0.12	0.177	0.05	0.1
2023	0.079	0.011	0.084	0.078	−0.001	0.027
2024	0.078	−0.007	0.051	0.114	0.002	0.05

Table 16: Average mendelian sampling by birth year. Animals are only included if they are not genotyped, their sire has > 30 offspring and their dam isn't genotyped.

BYR	m7	m8	m9	m10	m11	m12
2001	−0.083	0.309	−0.512	0.453	0.629	−0.4
2002	0.111	0.65	−0.921	0.282	0.858	−1.303
2003	−0.304	−0.131	−0.139	0.229	0.474	−0.281
2004	0.302	0.802	0.328	0.924	1.061	−0.008
2005	0.231	0.712	−0.505	0.769	1.17	−1.151

BYR	m7	m8	m9	m10	m11	m12
2006	0.393	0.526	−0.827	0.694	0.985	−0.663
2007	0.617	−0.154	−0.333	0.605	−0.241	−0.741
2008	0.847	1.569	−0.778	1.639	1.625	−0.264
2009	−0.125	0.391	−0.25	−0.117	0.461	−0.25
2010	0.474	1.069	−0.121	0.724	1.586	−0.034
2011	0.033	1.1	0.358	0.375	1.217	0.2
2012	1.0	1.526	−0.64	1.781	1.351	0.061
2013	1.085	1.5	0.538	1.17	1.17	0.302
2014	0.395	1.226	−0.589	1.177	1.411	0.097
2015	1.949	2.228	0.937	2.494	1.899	0.829
2016	0.87	1.468	0.494	1.266	0.922	0.669
2017	0.988	1.371	−0.324	1.259	1.241	0.247
2018	0.927	1.421	−0.09	0.938	1.343	0.011
2019	1.342	1.69	0.924	1.285	1.089	0.646
2020	1.343	1.014	0.814	1.286	0.457	0.686
2021	5.0	5.0	2.5	5.0	4.0	0.5

Reliabilities

Table 17: Comparison of reliabilities between single-step (ss), new EBV (ebv) and current official evaluation (cur) for nordic AI bulls with > 30 offspring and correlation between single-step and current evaluation.

BYR	trait	n	rel_ss	rel_ebv	rel_cur	s_rel_ss	s_rel_ebv	s_rel_cur	cor
2009	nysb1	224	87.91	75.49	77.14	4.28	7.83	7.26	0.93
2010	nysb1	194	88.48	76.03	77.77	4.74	9.32	8.57	0.96
2011	nysb1	154	90.15	78.61	79.91	3.64	7.5	7.12	0.97
2012	nysb1	171	91.27	79.9	81.44	4.62	10.09	9.29	0.98
2013	nysb1	151	91.83	80.1	81.62	4.54	10.23	9.59	0.98
2014	nysb1	113	94.08	84.0	85.52	4.89	11.87	10.72	0.98
2015	nysb1	82	96.13	88.09	89.32	3.8	9.76	8.83	0.98
2016	nysb1	65	95.99	87.22	88.31	3.48	9.31	8.52	0.97
2017	nysb1	66	96.19	87.36	88.59	3.92	10.49	9.65	0.98
2018	nysb1	78	95.34	84.21	86.0	4.23	11.56	10.25	0.96
2019	nysb1	56	95.58	84.14	86.95	4.25	11.56	9.61	0.95
2020	nysb1	45	95.46	83.7	88.5	4.18	11.66	9.14	0.91

BYR	trait	n	rel_ss	rel_ebv	rel_cur	s_rel_ss	s_rel_ebv	s_rel_cur	cor
2021	nysb1	9	95.0	81.93	91.86	3.66	10.69	8.92	0.88
2009	nyce1	224	87.46	75.49	85.79	4.42	7.83	5.21	0.92
2010	nyce1	194	88.06	76.03	85.86	4.91	9.32	6.16	0.94
2011	nyce1	154	89.78	78.61	87.8	3.78	7.5	4.94	0.94
2012	nyce1	170	91.04	80.05	88.6	4.68	9.91	6.61	0.96
2013	nyce1	151	91.54	80.1	88.68	4.71	10.23	6.76	0.96
2014	nyce1	111	94.08	84.46	91.66	4.84	11.44	7.21	0.97
2015	nyce1	82	96.0	88.09	94.13	3.94	9.76	5.59	0.98
2016	nyce1	65	95.85	87.22	93.67	3.61	9.31	5.08	0.98
2017	nyce1	66	96.06	87.36	93.55	4.05	10.49	6.5	0.98
2018	nyce1	78	95.18	84.21	91.8	4.38	11.56	6.93	0.96
2019	nyce1	56	95.42	84.14	92.64	4.4	11.56	6.36	0.96
2020	nyce1	45	95.29	83.7	93.7	4.34	11.66	5.71	0.91
2021	nyce1	9	94.82	81.93	95.51	3.8	10.69	6.06	0.85
2009	nycs1	159	87.92	76.17	−99.0	5.04	9.04	0.0	NaN
2010	nycs1	144	88.54	77.02	−99.0	5.46	10.41	0.0	NaN
2011	nycs1	114	89.97	79.25	−99.0	4.29	8.48	0.0	NaN
2012	nycs1	137	91.26	80.98	−99.0	5.19	10.77	0.0	NaN
2013	nycs1	113	91.96	81.68	−99.0	5.25	11.06	0.0	NaN
2014	nycs1	100	94.29	85.54	−99.0	4.94	11.17	0.0	NaN
2015	nycs1	78	95.95	88.45	−99.0	4.11	9.78	0.0	NaN
2016	nycs1	62	95.88	87.69	−99.0	3.72	9.22	0.0	NaN
2017	nycs1	65	96.04	87.67	−99.0	4.14	10.27	0.0	NaN
2018	nycs1	75	95.12	84.72	−99.0	4.56	11.45	0.0	NaN
2019	nycs1	52	95.77	85.44	−99.0	4.13	10.67	0.0	NaN
2020	nycs1	41	95.57	85.36	−99.0	4.39	10.6	0.0	NaN
2021	nycs1	9	94.68	81.93	−99.0	3.9	10.69	0.0	NaN
2009	nysb2	224	88.15	75.49	72.29	4.2	7.83	7.6	0.94
2010	nysb2	194	88.71	76.03	72.99	4.64	9.32	9.22	0.97
2011	nysb2	155	90.02	78.35	75.06	5.3	8.11	7.63	0.83
2012	nysb2	171	91.44	79.9	76.66	4.53	10.09	9.86	0.97
2013	nysb2	151	91.98	80.1	76.64	4.46	10.23	9.78	0.94
2014	nysb2	113	94.19	84.0	80.6	4.8	11.87	11.44	0.95

BYR	trait	n	rel_ss	rel_ebv	rel_cur	s_rel_ss	s_rel_ebv	s_rel_cur	cor
2015	nysb2	83	96.06	87.65	84.15	3.92	10.5	10.52	0.95
2016	nysb2	65	96.06	87.22	83.69	3.42	9.31	9.79	0.95
2017	nysb2	66	96.26	87.36	83.96	3.84	10.49	10.35	0.91
2018	nysb2	78	95.43	84.21	81.48	4.14	11.56	10.97	0.93
2019	nysb2	51	96.14	85.58	82.38	3.94	10.85	10.59	0.9
2020	nysb2	11	98.59	92.13	88.79	1.48	8.23	8.51	0.95
2009	nyce2	223	87.75	75.57	89.06	4.31	7.74	4.51	0.84
2010	nyce2	194	88.3	76.03	88.95	4.82	9.32	5.25	0.89
2011	nyce2	155	89.67	78.35	90.94	5.38	8.11	3.89	0.84
2012	nyce2	171	91.13	79.9	91.12	4.69	10.09	5.42	0.93
2013	nyce2	151	91.7	80.1	91.39	4.62	10.23	4.9	0.89
2014	nyce2	113	93.98	84.0	92.99	4.97	11.87	6.39	0.92
2015	nyce2	83	95.93	87.65	94.9	4.05	10.5	5.7	0.85
2016	nyce2	65	95.93	87.22	95.14	3.54	9.31	3.84	0.93
2017	nyce2	66	96.14	87.36	95.08	3.98	10.49	4.71	0.89
2018	nyce2	78	95.27	84.21	93.94	4.29	11.56	5.14	0.89
2019	nyce2	48	96.22	86.35	94.57	4.0	10.68	4.94	0.92
2020	nyce2	10	98.85	93.96	97.92	1.2	5.88	1.75	0.92
2009	nycs2	158	88.05	76.29	−99.0	4.97	8.94	0.0	NaN
2010	nycs2	144	88.59	77.02	−99.0	5.44	10.41	0.0	NaN
2011	nycs2	114	90.02	79.25	−99.0	4.27	8.48	0.0	NaN
2012	nycs2	137	91.3	80.98	−99.0	5.16	10.77	0.0	NaN
2013	nycs2	114	91.97	81.56	−99.0	5.2	11.08	0.0	NaN
2014	nycs2	104	94.1	84.9	−99.0	5.05	11.61	0.0	NaN
2015	nycs2	78	95.97	88.45	−99.0	4.09	9.78	0.0	NaN
2016	nycs2	62	95.9	87.69	−99.0	3.7	9.22	0.0	NaN
2017	nycs2	65	96.06	87.67	−99.0	4.11	10.27	0.0	NaN
2018	nycs2	75	95.15	84.72	−99.0	4.54	11.45	0.0	NaN
2019	nycs2	45	96.36	87.32	−99.0	4.0	10.13	0.0	NaN
2020	nycs2	8	99.12	95.51	−99.0	0.96	4.01	0.0	NaN

Table 18: Comparison of reliabilities between single-step and current official evaluation (two-step) for nordic genotyped bulls with no offspring

BYR	n	ss_rel	two_rel	s_ss_rel	s_two_rel	cor
2020	3109	61.671	76.78	0.0	1.313	4.36706e-14
2021	3129	61.671	76.44	0.0	1.319	4.26389e-16
2022	3208	61.671	75.966	0.0	1.448	1.42587e-14
2023	3035	61.671	73.902	0.0	2.247	9.87493e-15
2024	2941	61.671	71.839	0.0	1.162	4.78789e-14
2025	1275	61.671	71.298	0.0	1.263	3.17856e-14

Jersey

Genetic trends

Here, we exhibit the genetic trends of our evaluations for each trait. We see that the levels of breeding values are generally in agreement across evaluations.

Table 19: Genetic trends (Single-step (ss) vs new EBV (newebv) vs official EBV (offebv)) and correlation between single-step and official EBV for nordic AI bulls with at least 30 offspring in the full dataset

BYR	trait	n	m_ssm_newebv	m_offebv	s_ss	s_newebv	s_offebv	cor
2009	nysb1	50	92.38	92.2	91.93	10.56	9.91	9.63	0.95
2010	nysb1	55	93.33	94.15	93.9	9.27	8.35	8.15	0.93
2011	nysb1	47	91.11	91.06	90.96	8.77	8.57	8.19	0.93
2012	nysb1	47	94.28	94.74	94.68	11.37	11.71	11.22	0.96
2013	nysb1	49	95.22	95.82	95.63	8.3	8.49	8.23	0.95
2014	nysb1	36	94.53	94.53	94.31	9.43	9.52	9.17	0.95
2015	nysb1	30	101.13	100.93	100.57	7.31	7.53	7.19	0.87
2016	nysb1	26	98.96	98.81	98.53	8.79	9.53	9.08	0.94
2017	nysb1	29	100.34	100.41	100.12	8.68	8.83	8.48	0.96
2018	nysb1	20	96.9	96.3	96.36	11.72	12.01	11.47	0.98
2019	nysb1	29	104.38	104.03	103.49	7.4	7.35	7.0	0.96
2020	nysb1	19	99.21	97.74	97.48	9.21	9.53	9.2	0.98
2009	nyce1	50	96.0	96.68	96.28	9.51	9.84	9.26	0.96
2010	nyce1	55	94.04	94.69	94.58	9.79	9.52	9.13	0.93
2011	nyce1	47	94.89	96.26	95.94	8.76	9.12	8.71	0.91
2012	nyce1	47	96.62	97.13	96.87	8.97	10.04	9.62	0.94
2013	nyce1	49	96.33	97.84	97.48	9.78	10.58	9.98	0.94
2014	nyce1	36	96.81	97.08	96.8	8.64	9.1	8.59	0.97
2015	nyce1	30	102.87	103.3	102.65	5.81	6.64	6.3	0.96

BYR	trait	n	m_ssm_newebv	m_offebv	s_ss	s_newebv	s_offebv	cor
2016	nyce1	26	99.08	99.69	99.4	7.03	8.42	7.91	0.96
2017	nyce1	29	102.21	102.24	101.72	6.4	6.29	6.04	0.97
2018	nyce1	18	97.5	96.83	96.62	7.92	8.99	8.44	0.93
2019	nyce1	29	103.76	102.93	102.45	5.05	5.45	5.25	0.94
2020	nyce1	19	101.58	100.47	99.99	5.31	5.4	5.05	0.96
2009	nycs1	50	97.08	97.18	96.55	7.56	6.92	6.96	0.93
2010	nycs1	55	99.85	99.69	99.14	7.0	6.59	6.67	0.91
2011	nycs1	47	95.87	97.09	96.39	8.64	8.77	8.84	0.92
2012	nycs1	47	97.36	97.96	97.53	7.57	7.23	7.3	0.93
2013	nycs1	48	97.58	98.19	97.74	5.92	6.07	6.05	0.87
2014	nycs1	35	95.94	96.34	95.94	8.68	9.33	9.33	0.94
2015	nycs1	30	99.13	99.7	99.39	7.41	7.23	7.38	0.97
2016	nycs1	25	100.52	100.8	100.71	5.88	5.53	5.61	0.96
2017	nycs1	29	99.66	99.55	99.58	6.69	6.69	6.81	0.97
2018	nycs1	18	102.89	102.67	102.89	6.04	5.98	6.37	0.94
2019	nycs1	29	100.14	99.83	100.03	6.0	5.81	5.9	0.97
2020	nycs1	19	102.0	101.47	101.81	5.64	5.4	5.47	0.88
2009	nysb2	50	96.58	97.38	95.92	9.45	9.15	7.75	0.88
2010	nysb2	55	94.67	95.4	94.48	8.67	9.18	7.86	0.87
2011	nysb2	47	96.02	95.96	94.98	9.95	9.63	8.12	0.82
2012	nysb2	47	96.13	96.81	96.05	9.73	10.11	8.49	0.9
2013	nysb2	49	96.84	97.27	96.51	9.76	8.93	7.69	0.86
2014	nysb2	36	93.97	95.08	94.72	11.24	11.17	9.53	0.97
2015	nysb2	30	97.47	96.83	96.62	9.51	10.81	9.37	0.95
2016	nysb2	26	98.46	97.69	97.2	12.8	14.08	11.94	0.97
2017	nysb2	29	99.17	98.72	98.32	9.6	9.6	8.08	0.94
2018	nysb2	16	99.12	99.06	98.56	12.64	14.07	12.0	0.95
2019	nysb2	25	100.84	100.68	99.91	8.24	9.45	7.87	0.91
2009	nyce2	50	100.32	101.56	99.65	8.94	9.13	8.39	0.91
2010	nyce2	55	98.2	99.13	97.68	8.36	8.38	7.83	0.91
2011	nyce2	47	101.23	101.57	100.05	7.33	7.49	6.95	0.88
2012	nyce2	47	98.98	99.64	98.49	8.29	8.44	7.88	0.94
2013	nyce2	49	101.61	102.37	101.0	8.59	8.34	7.79	0.93

BYR	trait	n	m_ssm_newebv	m_offebv	s_ss	s_newebv	s_offebv	cor
2014	nyce2	36	99.86	100.53	99.33	8.32	8.5	7.83	0.95
2015	nyce2	30	102.87	103.27	102.38	7.47	8.37	7.83	0.96
2016	nyce2	25	100.48	101.48	100.68	8.71	8.54	7.74	0.94
2017	nyce2	29	102.93	102.48	101.89	7.95	7.36	6.78	0.91
2018	nyce2	15	97.53	97.2	96.65	8.12	9.05	8.19	0.91
2019	nyce2	23	98.78	98.7	98.47	9.26	8.46	7.71	0.93
2009	nycs2	50	94.5	94.64	92.88	8.05	7.92	7.91	0.96
2010	nycs2	55	97.62	97.29	95.65	7.43	7.2	7.05	0.92
2011	nycs2	47	94.53	94.34	92.71	8.77	8.85	8.7	0.94
2012	nycs2	47	97.09	97.15	95.91	6.89	6.46	6.55	0.91
2013	nycs2	49	96.04	95.92	94.73	6.32	6.39	6.32	0.89
2014	nycs2	36	97.28	97.25	96.29	7.11	7.65	7.54	0.92
2015	nycs2	30	98.8	98.2	97.82	6.82	6.79	6.79	0.94
2016	nycs2	25	99.84	98.92	98.73	6.14	6.12	6.18	0.95
2017	nycs2	29	99.55	99.48	99.81	6.92	6.95	7.02	0.97
2018	nycs2	14	103.64	104.21	104.42	6.98	6.48	6.82	0.93
2019	nycs2	23	101.13	101.13	101.94	7.1	6.98	6.96	0.96

Table 20: Genetic trends (Single-step full dataset (f) vs single-step reduced dataset (r)) for nordic AI bulls with at least 30 offspring in the full dataset

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2009	nysb1	50	93.12	93.72	10.47	10.67	1.72	0.98
2010	nysb1	55	94.09	95.16	9.22	9.68	1.84	0.98
2011	nysb1	47	91.89	92.3	8.68	9.4	1.81	0.97
2012	nysb1	47	95.11	95.23	11.28	12.1	2.0	0.98
2013	nysb1	49	96.0	96.63	8.16	8.52	1.82	0.96
2014	nysb1	36	95.36	95.58	9.33	10.34	2.39	0.96
2015	nysb1	30	101.77	102.37	7.2	7.25	1.67	0.95
2016	nysb1	26	99.77	100.04	8.75	7.07	5.96	0.6
2017	nysb1	29	101.07	101.48	8.48	5.51	6.48	0.39
2018	nysb1	20	97.75	100.25	11.57	5.72	8.4	0.39
2019	nysb1	29	105.21	103.03	7.38	5.38	5.76	0.5
2020	nysb1	19	99.89	101.21	9.12	4.61	7.11	0.34
2009	nyce1	50	96.94	97.06	9.43	9.15	1.2	0.99

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2010	nyce1	55	95.05	95.51	9.72	9.29	1.51	0.98
2011	nyce1	47	95.91	96.74	8.68	8.9	1.64	0.98
2012	nyce1	47	97.64	97.66	8.96	9.03	1.85	0.97
2013	nyce1	49	97.35	97.82	9.59	9.48	1.69	0.97
2014	nyce1	36	97.83	97.67	8.59	8.68	2.44	0.94
2015	nyce1	30	103.77	103.7	5.72	5.53	1.33	0.96
2016	nyce1	26	100.04	99.65	6.95	6.06	5.54	0.44
2017	nyce1	29	103.03	102.59	6.29	5.19	4.31	0.55
2018	nyce1	18	98.5	100.33	7.92	4.27	5.28	0.22
2019	nyce1	29	104.66	103.86	5.0	5.37	4.17	0.38
2020	nyce1	19	102.58	102.74	5.31	3.43	3.53	0.56
2009	nycs1	50	97.1	97.0	7.35	7.15	1.06	0.98
2010	nycs1	55	99.91	99.45	6.88	6.74	1.22	0.97
2011	nycs1	47	95.94	95.72	8.47	8.06	1.23	0.98
2012	nycs1	47	97.47	97.4	7.47	7.58	1.38	0.97
2013	nycs1	48	97.6	97.27	5.71	6.56	1.62	0.95
2014	nycs1	35	96.0	95.37	8.47	8.61	1.6	0.97
2015	nycs1	30	99.17	99.5	7.34	7.78	1.27	0.98
2016	nycs1	25	100.52	100.28	5.88	5.58	4.56	0.4
2017	nycs1	29	99.66	100.55	6.59	5.43	3.52	0.73
2018	nycs1	18	102.83	102.89	5.93	5.4	5.06	0.37
2019	nycs1	29	100.1	101.48	5.98	3.79	4.83	0.4
2020	nycs1	19	101.95	102.37	5.57	4.18	4.21	0.44
2009	nysb2	50	96.54	97.82	9.5	10.21	2.32	0.97
2010	nysb2	55	94.65	96.31	8.69	9.66	2.78	0.95
2011	nysb2	47	96.0	96.21	9.98	10.64	2.3	0.96
2012	nysb2	47	96.09	96.3	9.79	10.0	2.13	0.96
2013	nysb2	49	96.78	97.9	9.82	10.74	2.59	0.96
2014	nysb2	36	93.89	94.72	11.29	12.71	2.67	0.96
2015	nysb2	30	97.4	98.67	9.62	9.19	2.53	0.95
2016	nysb2	26	98.46	98.88	12.8	9.53	8.88	0.52
2017	nysb2	29	99.1	98.48	9.67	8.35	6.07	0.66
2018	nysb2	16	99.06	100.56	12.71	8.57	8.88	0.51

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2019	nysb2	25	100.84	100.76	8.24	8.79	7.52	0.25
2009	nyce2	50	99.96	100.48	8.69	8.64	1.24	0.98
2010	nyce2	55	97.84	98.02	8.13	7.99	1.2	0.98
2011	nyce2	47	100.83	100.68	7.16	7.5	1.34	0.97
2012	nyce2	47	98.6	98.77	8.09	8.31	1.62	0.97
2013	nyce2	49	101.16	101.27	8.47	8.73	1.86	0.96
2014	nyce2	36	99.56	100.5	8.22	8.4	1.67	0.97
2015	nyce2	30	102.37	102.4	7.42	7.38	1.7	0.96
2016	nyce2	25	100.16	100.44	8.56	6.29	6.28	0.43
2017	nyce2	29	102.34	101.41	7.79	6.3	5.62	0.55
2018	nyce2	15	97.4	101.67	8.04	4.45	7.73	0.14
2019	nyce2	23	98.43	102.57	9.1	6.27	7.43	0.48
2009	nycs2	50	93.2	93.06	7.99	7.66	0.78	0.99
2010	nycs2	55	96.18	96.09	7.2	7.13	0.89	0.99
2011	nycs2	47	93.13	93.15	8.56	8.46	0.96	0.99
2012	nycs2	47	95.62	95.81	6.8	6.78	1.0	0.98
2013	nycs2	49	94.47	94.39	6.12	6.43	0.82	0.99
2014	nycs2	36	96.0	95.92	7.01	7.28	1.14	0.98
2015	nycs2	30	97.4	97.77	6.78	6.63	1.1	0.98
2016	nycs2	25	98.4	97.96	6.12	4.77	3.24	0.7
2017	nycs2	29	98.1	97.83	6.78	4.8	4.07	0.6
2018	nycs2	14	102.29	99.86	6.7	5.78	4.43	0.64
2019	nycs2	23	99.57	98.87	7.11	3.9	4.09	0.73

Table 21: Genetic trends (Single-step full dataset (f) vs single-step reduced dataset (r)) for nordic cows with genotype and phenotype

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2009	nysb1	186	91.52	92.25	8.33	8.15	1.88	0.96
2010	nysb1	2206	92.08	92.76	7.12	7.04	2.03	0.94
2011	nysb1	3929	92.16	92.73	7.36	7.36	2.04	0.94
2012	nysb1	4085	93.69	94.28	7.72	7.79	2.11	0.94
2013	nysb1	2979	94.07	94.62	7.52	7.62	2.14	0.94
2014	nysb1	3558	93.3	93.93	7.43	7.5	2.19	0.93
2015	nysb1	3567	96.83	97.45	7.87	7.77	2.22	0.94

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2016	nysb1	3999	95.96	96.07	7.98	8.27	2.25	0.94
2017	nysb1	5284	97.62	98.06	7.57	7.53	2.36	0.92
2018	nysb1	6816	99.82	99.82	6.9	6.74	3.08	0.83
2019	nysb1	7754	99.15	99.57	7.15	6.44	3.77	0.77
2020	nysb1	8289	100.31	100.48	7.77	6.34	4.43	0.7
2021	nysb1	8320	101.12	100.58	7.63	5.84	4.49	0.65
2022	nysb1	8336	101.77	101.82	6.92	5.61	3.97	0.7
2023	nysb1	4567	101.28	100.95	6.86	5.29	4.03	0.68
2009	nyce1	183	93.97	94.3	7.21	6.85	2.05	0.93
2010	nyce1	2182	94.18	94.55	6.86	6.8	1.94	0.94
2011	nyce1	3883	95.16	95.69	6.95	6.76	2.03	0.93
2012	nyce1	4008	95.72	96.14	7.26	7.1	2.03	0.94
2013	nyce1	2894	95.98	96.41	7.19	6.96	2.09	0.93
2014	nyce1	3469	96.41	96.85	7.02	6.88	2.21	0.92
2015	nyce1	3466	98.45	98.78	7.4	7.29	2.26	0.93
2016	nyce1	3882	97.65	97.52	7.29	7.25	2.24	0.92
2017	nyce1	5134	100.32	100.44	6.87	6.76	2.25	0.91
2018	nyce1	6681	100.4	100.4	6.47	6.34	2.77	0.84
2019	nyce1	7467	100.76	100.96	6.57	6.21	3.38	0.77
2020	nyce1	7727	101.35	100.94	6.53	5.81	3.35	0.77
2021	nyce1	7657	101.65	101.87	6.34	5.78	3.62	0.7
2022	nyce1	7757	101.85	101.96	5.9	5.53	3.18	0.75
2023	nyce1	4334	101.9	101.94	5.95	5.15	3.32	0.72
2009	nycs1	168	97.0	96.83	7.71	7.51	1.43	0.97
2010	nycs1	2013	98.51	98.18	6.44	6.37	1.56	0.95
2011	nycs1	3589	97.68	97.41	6.49	6.38	1.55	0.95
2012	nycs1	3740	97.88	97.62	6.21	6.07	1.56	0.95
2013	nycs1	2740	97.68	97.4	6.03	5.94	1.63	0.94
2014	nycs1	3298	97.09	96.88	5.99	5.86	1.6	0.94
2015	nycs1	3243	97.72	97.84	6.09	5.96	1.68	0.94
2016	nycs1	3678	98.12	98.09	6.03	5.91	1.65	0.94
2017	nycs1	4899	98.08	98.22	6.15	6.17	1.79	0.93
2018	nycs1	6438	97.95	98.22	6.25	6.31	2.39	0.87

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2019	nycs1	7052	98.15	98.59	5.69	5.52	2.7	0.81
2020	nycs1	7282	100.29	100.46	6.23	5.32	2.85	0.81
2021	nycs1	7154	100.16	100.41	5.96	4.87	3.3	0.72
2022	nycs1	7099	99.34	100.4	5.51	4.84	3.26	0.71
2023	nycs1	3866	99.69	100.44	5.56	4.72	3.02	0.75
2009	nysb2	181	94.35	94.89	8.61	8.86	2.25	0.94
2010	nysb2	2100	95.6	96.48	8.31	8.61	2.46	0.94
2011	nysb2	3246	96.23	97.1	8.13	8.43	2.52	0.93
2012	nysb2	3260	96.71	97.64	7.98	8.19	2.64	0.92
2013	nysb2	2452	97.38	98.47	8.35	8.7	2.65	0.93
2014	nysb2	2940	96.49	97.25	8.19	8.29	2.64	0.92
2015	nysb2	3093	97.94	98.82	8.1	8.19	2.76	0.91
2016	nysb2	3232	97.56	98.28	8.8	9.19	2.82	0.93
2017	nysb2	3952	97.64	98.28	8.62	8.77	2.96	0.91
2018	nysb2	4533	99.6	100.46	8.52	8.64	3.95	0.82
2019	nysb2	4707	99.76	99.67	8.47	8.5	4.97	0.73
2020	nysb2	4665	99.58	100.16	9.72	8.44	4.85	0.78
2021	nysb2	3861	100.73	100.3	8.78	8.02	5.55	0.66
2022	nysb2	1657	100.29	100.75	8.63	8.16	4.43	0.77
2009	nyce2	180	98.61	98.89	7.76	7.55	1.78	0.96
2010	nyce2	2074	98.23	98.39	7.32	7.18	1.72	0.95
2011	nyce2	3181	99.17	99.45	7.28	7.11	1.78	0.95
2012	nyce2	3205	99.36	99.56	6.98	6.84	1.72	0.95
2013	nyce2	2398	99.51	99.79	6.99	6.87	1.84	0.94
2014	nyce2	2864	99.79	100.04	6.93	6.69	1.92	0.94
2015	nyce2	3005	100.99	101.35	6.83	6.6	2.02	0.93
2016	nyce2	3142	100.79	101.24	7.01	6.9	2.05	0.93
2017	nyce2	3856	101.63	101.85	7.11	6.79	2.23	0.91
2018	nyce2	4391	101.94	101.76	6.73	6.41	2.73	0.85
2019	nyce2	4450	100.93	101.99	6.89	6.06	3.57	0.77
2020	nyce2	4369	100.79	101.3	7.34	6.08	4.17	0.71
2021	nyce2	3560	100.08	102.52	6.73	5.96	4.27	0.72
2022	nyce2	1586	99.92	101.62	6.69	5.72	4.04	0.71

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2009	nycs2	170	95.32	95.19	6.75	6.7	1.03	0.98
2010	nycs2	2005	95.64	95.46	6.23	6.17	1.11	0.97
2011	nycs2	3051	94.8	94.65	6.26	6.16	1.09	0.97
2012	nycs2	3025	94.93	94.8	6.1	5.96	1.13	0.97
2013	nycs2	2297	94.81	94.78	5.97	5.85	1.17	0.97
2014	nycs2	2758	95.28	95.24	6.19	6.05	1.18	0.97
2015	nycs2	2831	95.2	95.21	6.15	5.99	1.21	0.97
2016	nycs2	2996	95.87	95.86	5.68	5.59	1.26	0.96
2017	nycs2	3674	96.36	96.39	6.25	6.09	1.32	0.96
2018	nycs2	4171	95.77	95.82	6.4	6.13	1.83	0.92
2019	nycs2	4177	96.77	96.64	5.8	5.4	2.27	0.86
2020	nycs2	4046	98.8	97.77	6.25	5.33	2.92	0.82
2021	nycs2	3172	98.89	98.21	6.09	5.0	2.81	0.82
2022	nycs2	1363	98.69	97.82	5.88	4.86	2.88	0.81

Correlations

Here, we give correlation tables and tables of differences between the relevant evaluations. We test that we didn't change the model by comparing our new model without genomic information to the breeding values of the traditional pedigree-based model and expect very high correlations for tested animals. We test the change by incorporating genomic information, compared to a non-genomic evaluation, and expect to see some changes even in tested animals, but not too large.

Table 22: Correlations between current EBV and new EBV for Nordic AI bulls with > 30 offspring in nysb1

BYR	n	cor7	cor8	cor9	cor10	cor11	cor12
2009	50	0.999	0.998	0.997	0.996	0.998	0.998
2010	55	0.998	0.999	0.999	0.996	0.998	0.998
2011	47	0.999	0.999	0.999	0.997	0.997	0.999
2012	47	1.0	0.999	0.999	0.997	0.998	0.998
2013	49	0.999	0.999	0.999	0.996	0.998	0.997
2014	36	0.999	0.999	0.999	0.998	0.998	0.999
2015	30	0.999	0.998	0.999	0.998	0.998	0.997
2016	26	0.999	0.999	0.998	0.999	0.998	0.997
2017	29	0.999	0.998	0.999	0.996	0.996	0.997
2018	20	0.999	0.998	0.999	0.998	0.997	0.996

BYR	n	cor7	cor8	cor9	cor10	cor11	cor12
2019	29	0.999	0.998	0.998	0.996	0.999	0.993
2020	19	1.0	0.998	0.999	0.999	0.998	0.995

Table 23: Table of differences between current EBV and new EBV for Nordic AI bulls with > 30 offspring in nysb1 born after 2015

dif	dif7	dif8	dif9	dif10	dif11	dif12
−6.0	0	0	0	1	0	0
−5.0	0	0	0	0	0	0
−4.0	0	0	0	4	0	0
−3.0	0	0	0	16	1	0
−2.0	1	1	0	17	17	1
−1.0	41	52	7	28	54	17
0.0	75	66	97	27	37	66
1.0	10	7	23	17	15	39
2.0	0	1	0	13	3	4
3.0	0	0	0	3	0	0
4.0	0	0	0	0	0	0
5.0	0	0	0	0	0	0
6.0	0	0	0	1	0	0

Table 24: Correlations between current EBV and new Single-step for AI bulls with > 30 offspring in nysb1

BYR	n	cor7	cor8	cor9	cor10	cor11	cor12
2009	50	0.951	0.96	0.926	0.881	0.915	0.96
2010	55	0.932	0.929	0.912	0.867	0.91	0.916
2011	47	0.926	0.914	0.922	0.823	0.879	0.944
2012	47	0.965	0.939	0.928	0.899	0.94	0.908
2013	49	0.946	0.945	0.872	0.858	0.928	0.886
2014	36	0.954	0.969	0.936	0.972	0.953	0.916
2015	30	0.871	0.958	0.97	0.948	0.959	0.944
2016	26	0.945	0.961	0.963	0.966	0.935	0.939
2017	29	0.965	0.968	0.969	0.935	0.914	0.97
2018	20	0.976	0.91	0.914	0.92	0.871	0.894
2019	29	0.962	0.941	0.968	0.919	0.916	0.944
2020	19	0.979	0.958	0.881	0.767	0.818	0.727

Table 25: Table of differences between current EBV and new Single-step for AI bulls with > 30 offspring in nysb1 born after 2015

dif	dif7	dif8	dif9	dif10	dif11	dif12
−11.0	0	0	0	1	1	0
−10.0	0	0	0	2	2	0
−9.0	0	1	0	2	0	0
−8.0	1	0	1	0	2	2
−7.0	2	1	0	5	5	1
−6.0	1	2	1	3	1	2
−5.0	4	1	2	11	5	3
−4.0	2	5	4	9	4	5
−3.0	10	11	7	5	11	7
−2.0	16	24	6	15	13	14
−1.0	35	28	18	16	16	14
0.0	23	27	42	14	24	24
1.0	17	9	24	12	11	25
2.0	9	9	8	7	11	13
3.0	2	5	9	6	7	10
4.0	2	3	4	4	4	2
5.0	0	0	1	7	4	2
6.0	0	0	0	1	1	1
7.0	3	0	0	2	2	1
8.0	0	1	0	2	1	0
9.0	0	0	0	2	1	1
10.0	0	0	0	0	0	0
11.0	0	0	0	1	1	0

Table 26: Correlations between current two-step and new Single-step (combined calving index) for genotyped AI bulls born after 2009 with > 30 offspring

BYR	n	cor
2009	50	0.936
2010	55	0.919
2011	47	0.927
2012	47	0.932
2013	49	0.913

BYR	n	cor
2014	36	0.956
2015	30	0.859
2016	25	0.964
2017	28	0.848
2018	20	0.913
2019	29	0.877
2020	19	0.733

Table 27: Table of differences between current two-step and new Single-step (combined calving index) for genotyped AI bulls with > 30 offspring born after 2015

dif	dif14
−10.0	1
−9.0	2
−8.0	1
−7.0	2
−6.0	2
−5.0	6
−4.0	4
−3.0	9
−2.0	9
−1.0	16
0.0	8
1.0	17
2.0	8
3.0	7
4.0	8
5.0	6
6.0	6
7.0	7
8.0	1
9.0	1
10.0	1
11.0	1
12.0	1

dif	dif14
13.0	0
14.0	0
15.0	0
16.0	0
17.0	1

Table 28: Correlations between current two-step and new Single-step for genotyped nordic bulls with no offspring born after 2020

BYR	n	cor
2020	464	0.729
2021	408	0.723
2022	487	0.632
2023	633	0.664
2024	674	0.627
2025	261	0.619

Table 29: Table of differences between current two-step and new Single-step for genotyped nordic bulls born after 2020 with no offspring

dif	dif14
−17.0	1
−16.0	0
−15.0	8
−14.0	5
−13.0	12
−12.0	7
−11.0	15
−10.0	27
−9.0	44
−8.0	61
−7.0	58
−6.0	83
−5.0	114
−4.0	148
−3.0	157
−2.0	185

dif	dif14
−1.0	161
0.0	162
1.0	180
2.0	183
3.0	187
4.0	128
5.0	115
6.0	121
7.0	95
8.0	65
9.0	50
10.0	37
11.0	21
12.0	14
13.0	6
14.0	9
15.0	2
16.0	2
17.0	2

Legarra-Reverter test

The Legarra-Reverter test is a test for bias in evaluations. We perform two calculations of breeding values, one with all information available and one where offspring of sires born after 2018 has their records removed. Then we perform a linear regression on genotyped, nordic bulls, who has no data in the reduced dataset and with more than 30 offspring in the full dataset. We also require that their sires are not in the focal group, so we remove bulls whose father meets the same criteria.

The slope of the regression indicates the bias, with a slope of one meaning no bias, a slope less than one indicating that the estimated values of unproven animals are too extreme, and a slope higher than one indicating that the estimated breeding values of unproven animals are too conservative.

As can be seen, we have some issues with the Legarra-Reverter test. We're looking into it.

Table 30: Legarra-Reverter scores
Singlestep:

trait	b1	rsquare	n
nysb1	0.761	0.229	119
nyce1	0.595	0.23	117
nycs1	0.607	0.25	116
nysb2	0.635	0.261	96
nyce2	0.605	0.173	91
nycs2	0.958	0.469	90

EBV:

trait	b1	rsquare	n
nysb1	0.549	0.075	119
nyce1	0.489	0.088	117
nycs1	0.44	0.081	116
nysb2	0.594	0.1	96
nyce2	0.28	0.017	91
nycs2	0.614	0.112	90

Mendelian sampling

The mendelian sampling of an animals is its deviation of its breeding values from the expected breeding value, which is the average of its parents breeding values. Some mendelian samling is expected on the individual level (this is what enables breeding), but across all animals we expect it to be close to zero. Otherwise, this indicates a bias in the set of animals in the evaluation, which violates the unbiasedness of the BLUP model. We conclude that the mendelian sampling is generally close to 0.

Table 31: Average mendelian sampling by birth year. Animals are only included if they are genotyped, their sire has > 30 offspring in nysb1 and their dam is genotyped.

BYR	m7	m8	m9	m10	m11	m12
2010	0.143	0.173	0.187	−0.585	0.038	−0.234
2011	−0.809	−0.496	−0.014	−0.646	0.174	−0.002
2012	0.021	−0.349	0.027	0.02	−0.229	0.044
2013	−0.126	−0.134	−0.147	−0.121	0.086	−0.109
2014	−0.103	−0.159	−0.083	0.066	0.067	−0.111
2015	0.138	0.145	−0.152	0.205	0.161	−0.015
2016	0.128	0.233	0.009	0.096	0.047	0.093
2017	0.103	0.125	0.034	0.197	0.034	0.01
2018	0.128	0.057	0.001	0.231	0.062	−0.025

BYR	m7	m8	m9	m10	m11	m12
2019	−0.114	−0.028	−0.143	0.004	0.081	−0.085
2020	0.076	0.038	0.011	0.069	0.045	−0.007
2021	0.055	0.053	0.032	0.102	0.036	0.034
2022	0.083	−0.013	0.022	0.091	0.001	0.024
2023	0.097	−0.023	0.088	0.051	0.064	−0.025
2024	0.049	−0.095	−0.08	0.061	0.06	−0.107

Table 32: Average mendelian sampling by birth year. Animals are only included if they are not genotyped, their sire has > 30 offspring and their dam isn't genotyped.

BYR	m7	m8	m9	m10	m11	m12
2003	2.833	2.5	0.5	−3.833	−2.333	−0.5
2001	1.25	−2.75	−1.5	−3.25	−3.75	−2.0
2002	−1.625	1.562	1.688	−2.188	−0.438	0.875
2005	1.0	3.833	2.5	0.667	5.667	0.833
2006	−0.5	0.857	0.429	−2.0	−0.286	0.857
2008	6.0	8.0	8.0	−6.5	−1.5	4.0
2007	0.75	0.0	1.0	0.75	2.25	−0.25
2010	−3.375	−6.688	−0.25	−4.688	−4.688	1.125
2013	0.719	2.625	−0.812	1.094	4.156	−0.906
2009	−1.667	0.0	0.167	0.5	−2.333	1.0
2011	−1.286	3.143	1.286	0.5	3.0	1.0
2012	−1.667	−0.556	0.278	−1.556	0.556	0.389
2014	0.333	0.167	0.5	−3.0	−3.667	2.5
2015	0.182	2.909	0.364	0.545	3.182	−0.045
2017	−1.917	0.417	−0.083	−0.917	−0.25	−0.167
2016	−0.714	3.214	1.143	1.143	3.357	1.0
2018	−4.167	1.333	2.667	−5.333	3.333	1.333
2019	−1.0	−1.0	0.25	−1.5	−0.25	2.0

Reliabilities

Table 33: Comparison of reliabilities between single-step (ss), new EBV (ebv) and current official evaluation (cur) for nordic AI bulls with > 30 offspring and correlation between single-step and current evaluation.

BYR	trait	n	rel_ss	rel_ebv	rel_cur	s_rel_ss	s_rel_ebv	s_rel_cur	cor
2009	nysb1	50	84.01	66.75	70.08	6.38	10.81	10.17	0.95

BYR	trait	n	rel_ss	rel_ebv	rel_cur	s_rel_ss	s_rel_ebv	s_rel_cur	cor
2010	nysb1	55	81.57	64.48	68.04	8.27	11.64	11.13	0.96
2011	nysb1	47	81.63	63.14	67.22	7.3	10.88	10.4	0.96
2012	nysb1	47	81.71	64.04	67.36	8.83	13.91	13.09	0.95
2013	nysb1	49	80.22	60.5	63.89	9.17	14.87	14.12	0.97
2014	nysb1	36	84.22	67.31	70.41	11.37	18.3	17.28	0.98
2015	nysb1	30	93.43	82.02	84.3	7.36	14.76	13.53	0.97
2016	nysb1	26	91.33	75.35	77.53	8.24	17.35	16.58	0.97
2017	nysb1	29	95.03	84.0	86.4	7.01	13.69	12.44	0.95
2018	nysb1	20	86.35	68.68	72.66	11.58	20.44	18.71	0.97
2019	nysb1	29	95.05	82.32	85.63	6.08	15.05	13.34	0.98
2020	nysb1	19	95.81	84.77	91.04	4.0	10.23	6.91	0.73
2021	nysb1	4	92.37	78.77	93.28	5.39	5.79	1.11	0.48
2009	nyce1	50	83.94	66.75	68.16	6.41	10.81	9.92	0.95
2010	nyce1	55	81.49	64.48	66.39	8.3	11.64	10.48	0.96
2011	nyce1	47	81.55	63.14	65.48	7.33	10.88	9.71	0.97
2012	nyce1	47	81.63	64.04	65.79	8.87	13.91	12.66	0.94
2013	nyce1	49	80.13	60.5	62.67	9.21	14.87	13.35	0.97
2014	nyce1	36	84.15	67.31	68.74	11.42	18.3	16.4	0.97
2015	nyce1	30	93.4	82.02	82.02	7.39	14.76	13.6	0.98
2016	nyce1	26	91.29	75.35	75.32	8.28	17.35	15.92	0.97
2017	nyce1	29	95.0	84.0	84.09	7.05	13.69	12.42	0.94
2018	nyce1	18	87.77	71.36	73.11	11.3	19.77	17.63	0.95
2019	nyce1	29	95.02	82.32	82.56	6.11	15.05	14.16	0.97
2020	nyce1	19	95.79	84.77	88.12	4.02	10.23	7.33	0.76
2021	nyce1	4	92.33	78.77	90.38	5.41	5.79	1.51	0.4
2009	nycs1	50	82.78	66.75	−99.0	6.84	10.81	0.0	NaN
2010	nycs1	55	80.28	64.48	−99.0	8.77	11.64	0.0	NaN
2011	nycs1	47	80.3	63.14	−99.0	7.79	10.88	0.0	NaN
2012	nycs1	47	80.43	64.04	−99.0	9.39	13.91	0.0	NaN
2013	nycs1	48	78.97	60.8	−99.0	9.81	14.87	0.0	NaN
2014	nycs1	35	83.52	67.84	−99.0	12.01	18.29	0.0	NaN
2015	nycs1	30	92.89	82.02	−99.0	7.94	14.76	0.0	NaN
2016	nycs1	25	91.32	76.62	−99.0	8.28	16.43	0.0	NaN

BYR	trait	n	rel_ss	rel_ebv	rel_cur	s_rel_ss	s_rel_ebv	s_rel_cur	cor
2017	nycs1	29	94.61	84.0	−99.0	7.55	13.69	0.0	NaN
2018	nycs1	18	86.86	71.36	−99.0	12.05	19.77	0.0	NaN
2019	nycs1	29	94.58	82.32	−99.0	6.64	15.05	0.0	NaN
2020	nycs1	19	95.41	84.77	−99.0	4.38	10.23	0.0	NaN
2021	nycs1	4	91.7	78.77	−99.0	5.79	5.79	0.0	NaN
2009	nysb2	50	84.27	66.75	71.5	6.29	10.81	9.42	0.95
2010	nysb2	55	81.85	64.48	69.86	8.16	11.64	10.09	0.96
2011	nysb2	47	81.91	63.14	68.82	7.2	10.88	9.11	0.97
2012	nysb2	47	81.98	64.04	69.1	8.71	13.91	11.87	0.95
2013	nysb2	49	80.51	60.5	66.85	9.04	14.87	12.33	0.97
2014	nysb2	36	84.45	67.31	72.24	11.22	18.3	15.47	0.98
2015	nysb2	30	93.55	82.02	84.72	7.23	14.76	11.63	0.97
2016	nysb2	26	91.48	75.35	78.56	8.1	17.35	14.69	0.96
2017	nysb2	29	95.11	84.0	85.77	6.9	13.69	10.65	0.93
2018	nysb2	16	90.16	74.22	77.58	9.72	19.09	14.41	0.96
2019	nysb2	25	96.81	86.32	85.9	3.86	11.42	9.43	0.96
2020	nysb2	6	98.72	92.69	90.02	0.5	1.95	2.21	0.98
2009	nyce2	50	84.07	66.75	75.19	6.36	10.81	8.73	0.96
2010	nyce2	55	81.63	64.48	73.81	8.25	11.64	9.74	0.96
2011	nyce2	47	81.69	63.14	72.83	7.28	10.88	8.83	0.97
2012	nyce2	47	81.77	64.04	72.82	8.81	13.91	11.11	0.95
2013	nyce2	49	80.28	60.5	71.04	9.14	14.87	11.52	0.97
2014	nyce2	36	84.27	67.31	75.96	11.34	18.3	14.51	0.98
2015	nyce2	30	93.46	82.02	87.36	7.33	14.76	10.79	0.97
2016	nyce2	25	92.03	76.62	82.95	7.62	16.43	12.76	0.95
2017	nyce2	29	95.05	84.0	88.5	6.99	13.69	9.89	0.94
2018	nyce2	15	90.96	75.64	81.77	9.42	18.87	13.18	0.96
2019	nyce2	23	97.67	88.63	90.3	2.31	8.29	6.76	0.94
2020	nyce2	6	98.7	92.69	92.58	0.5	1.95	1.91	0.98
2009	nycs2	50	82.7	66.75	−99.0	6.87	10.81	0.0	NaN
2010	nycs2	55	80.19	64.48	−99.0	8.8	11.64	0.0	NaN
2011	nycs2	47	80.2	63.14	−99.0	7.82	10.88	0.0	NaN
2012	nycs2	47	80.34	64.04	−99.0	9.43	13.91	0.0	NaN

BYR	trait	n	rel_ss	rel_ebv	rel_cur	s_rel_ss	s_rel_ebv	s_rel_cur	cor
2013	nycs2	49	78.7	60.5	−99.0	9.82	14.87	0.0	NaN
2014	nycs2	36	83.02	67.31	−99.0	12.16	18.3	0.0	NaN
2015	nycs2	30	92.86	82.02	−99.0	7.98	14.76	0.0	NaN
2016	nycs2	25	91.27	76.62	−99.0	8.32	16.43	0.0	NaN
2017	nycs2	29	94.58	84.0	−99.0	7.59	13.69	0.0	NaN
2018	nycs2	14	90.76	76.88	−99.0	10.31	18.94	0.0	NaN
2019	nycs2	23	97.42	88.63	−99.0	2.57	8.29	0.0	NaN
2020	nycs2	6	98.57	92.69	−99.0	0.56	1.95	0.0	NaN

Table 34: Comparison of reliabilities between single-step and current official evaluation (two-step) for nordic genotyped bulls with no offspring

BYR	n	ss_rel	two_rel	s_ss_rel	s_two_rel	cor
2020	457	NaN	58.275	NaN	4.038	NaN
2021	380	NaN	57.24	NaN	3.594	NaN
2022	453	NaN	55.822	NaN	3.518	NaN
2023	599	NaN	52.255	NaN	3.499	NaN
2024	645	NaN	50.056	NaN	2.551	NaN
2025	261	NaN	48.888	NaN	1.915	NaN

RDC

Genetic trends

Here, we exhibit the genetic trends of our evaluations for each trait. We see that the levels of breeding values are generally in agreement across evaluations.

Table 35: Genetic trends (Single-step (ss) vs new EBV (newebv) vs official EBV (offebv)) and correlation between single-step and official EBV for nordic AI bulls with at least 30 offspring in the full dataset

BYR	trait	n	m_ssm_newebv	m_offebv	s_ss	s_newebv	s_offebv	cor
2009	nysb1	156	96.6	97.54	97.73	8.69	8.94	7.34	0.92
2010	nysb1	163	96.23	97.42	97.81	10.72	11.42	9.57	0.94
2011	nysb1	166	95.45	96.02	96.61	10.01	10.09	8.51	0.93
2012	nysb1	167	98.14	98.35	98.56	8.36	8.6	7.03	0.91
2013	nysb1	117	98.6	99.55	99.6	8.37	8.61	7.06	0.9
2014	nysb1	84	97.35	97.63	98.06	10.37	10.4	8.39	0.95
2015	nysb1	71	97.94	98.01	98.5	9.45	9.58	7.64	0.95

BYR	trait	n	m_ssm	m_newebv	m_offebv	s_ss	s_newebv	s_offebv	cor
2016	nysb1	70	98.27	97.9	98.56	9.86	9.56	7.73	0.96
2017	nysb1	66	98.91	98.95	99.53	8.44	8.43	7.07	0.95
2018	nysb1	52	99.54	99.75	100.18	8.66	8.03	6.85	0.93
2019	nysb1	48	100.62	99.42	100.19	11.09	11.67	9.44	0.97
2020	nysb1	45	100.04	100.09	100.53	8.84	9.55	7.87	0.94
2009	nyce1	155	93.06	94.37	94.76	10.54	10.7	9.55	0.96
2010	nyce1	162	94.55	95.74	95.94	10.35	10.81	9.66	0.94
2011	nyce1	162	94.83	95.44	95.71	10.16	10.29	9.26	0.94
2012	nyce1	164	98.69	98.69	98.65	10.01	10.2	8.98	0.95
2013	nyce1	115	98.18	98.46	98.51	9.83	9.82	8.82	0.95
2014	nyce1	83	99.29	99.11	99.1	8.39	8.94	7.95	0.94
2015	nyce1	71	97.55	97.04	97.58	9.73	10.01	8.57	0.97
2016	nyce1	69	99.48	99.17	99.38	9.6	9.24	8.28	0.96
2017	nyce1	63	99.73	99.48	99.68	8.35	8.49	7.66	0.96
2018	nyce1	52	100.63	99.94	100.25	8.3	7.98	7.18	0.96
2019	nyce1	47	102.43	100.91	101.22	8.8	8.59	7.82	0.96
2020	nyce1	44	101.0	99.57	99.98	8.87	8.35	7.53	0.93
2009	nycs1	33	102.09	102.3	102.5	13.15	12.8	12.8	0.97
2010	nycs1	38	99.05	99.66	99.74	13.71	13.85	13.69	0.96
2011	nycs1	38	101.66	102.24	102.48	10.77	10.24	10.15	0.96
2012	nycs1	49	101.49	101.08	101.1	14.03	14.09	14.0	0.98
2013	nycs1	38	101.08	101.29	101.25	11.52	11.98	11.99	0.96
2014	nycs1	27	98.19	97.96	98.04	13.07	13.04	13.05	0.97
2015	nycs1	30	98.27	98.53	98.35	13.41	13.41	13.36	0.99
2016	nycs1	26	103.27	103.15	103.12	14.03	14.16	14.14	0.99
2017	nycs1	28	98.61	98.68	98.5	11.18	10.94	10.81	0.96
2018	nycs1	27	104.48	104.78	104.61	11.94	11.01	10.95	0.96
2019	nycs1	23	101.61	101.04	100.78	12.85	12.61	12.59	0.97
2020	nycs1	19	100.68	100.63	100.34	8.28	8.79	8.73	0.93
2009	nysb2	156	97.71	98.42	97.63	8.45	9.15	8.74	0.92
2010	nysb2	163	100.0	100.88	100.12	9.07	10.07	9.49	0.93
2011	nysb2	166	98.52	99.01	98.43	8.02	8.68	8.16	0.89
2012	nysb2	167	99.87	100.17	99.55	7.83	8.23	7.86	0.91

BYR	trait	n	m_ssm_newebv	m_offebv	s_ss	s_newebv	s_offebv	cor
2013	nysb2	120	101.51	102.01	101.47	8.11	8.01	7.54	0.89
2014	nysb2	84	99.93	100.42	100.25	7.93	8.35	7.97	0.92
2015	nysb2	71	99.1	98.99	98.99	8.6	9.4	8.63	0.93
2016	nysb2	70	100.01	100.1	100.0	8.83	9.03	8.41	0.93
2017	nysb2	66	99.3	99.77	100.13	7.84	7.96	7.55	0.93
2018	nysb2	51	99.76	99.94	100.49	7.77	7.08	6.71	0.86
2019	nysb2	38	99.11	98.63	99.37	9.49	10.08	9.19	0.92
2009	nyce2	153	93.01	94.5	95.08	10.84	11.2	9.31	0.96
2010	nyce2	162	96.65	97.62	97.74	10.33	10.78	8.94	0.94
2011	nyce2	165	97.6	98.18	98.21	9.67	10.26	8.8	0.94
2012	nyce2	164	100.07	100.53	100.16	8.95	9.49	7.91	0.92
2013	nyce2	115	99.43	99.78	99.71	8.31	8.39	6.94	0.93
2014	nyce2	83	100.54	100.64	100.69	6.42	6.93	5.89	0.92
2015	nyce2	71	100.01	99.41	99.78	9.01	9.43	7.78	0.96
2016	nyce2	69	100.99	100.33	100.5	8.38	8.95	7.6	0.95
2017	nyce2	64	100.31	100.73	100.93	6.88	6.54	5.37	0.92
2018	nyce2	47	100.83	100.53	101.0	6.52	6.51	5.33	0.92
2019	nyce2	36	102.58	102.31	102.43	6.69	6.23	5.35	0.88
2009	nycs2	36	99.39	99.86	99.53	12.65	12.14	12.06	0.96
2010	nycs2	39	97.59	98.26	97.92	9.52	9.27	9.09	0.95
2011	nycs2	42	100.24	101.26	101.09	11.0	11.09	11.08	0.97
2012	nycs2	49	99.9	100.04	99.84	10.08	11.17	10.91	0.98
2013	nycs2	40	100.92	101.4	101.17	9.82	10.14	9.95	0.97
2014	nycs2	28	96.18	96.14	96.16	12.29	12.89	12.57	0.99
2015	nycs2	31	97.23	97.39	97.28	11.33	11.1	10.95	0.98
2016	nycs2	27	100.59	101.15	101.06	13.92	13.95	13.78	0.99
2017	nycs2	26	100.92	100.62	100.44	8.74	8.95	8.68	0.97
2018	nycs2	24	104.5	104.54	104.32	11.5	10.99	10.76	0.98
2019	nycs2	16	103.5	103.12	102.94	9.75	9.34	9.2	0.95

Table 36: Genetic trends (Single-step full dataset (f) vs single-step reduced dataset (r)) for nordic AI bulls with at least 30 offspring in the full dataset

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2009	nysb1	156	97.12	97.17	7.76	7.83	1.27	0.98

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2010	nysb1	163	96.82	96.99	9.64	9.77	1.49	0.98
2011	nysb1	166	96.13	96.05	8.97	8.84	1.51	0.98
2012	nysb1	167	98.54	98.46	7.49	7.62	1.39	0.97
2013	nysb1	117	98.92	99.17	7.53	7.07	1.41	0.97
2014	nysb1	84	97.77	98.4	9.25	9.45	1.87	0.97
2015	nysb1	71	98.42	97.7	8.43	9.14	2.1	0.96
2016	nysb1	70	98.63	100.2	8.88	7.31	4.51	0.76
2017	nysb1	66	99.3	98.38	7.53	6.3	5.38	0.57
2018	nysb1	52	99.81	100.52	7.77	7.06	5.21	0.58
2019	nysb1	48	100.77	99.73	9.95	5.58	6.58	0.49
2020	nysb1	45	100.36	98.58	7.89	5.65	5.87	0.52
2009	nyce1	155	94.08	94.04	9.79	9.72	0.86	0.99
2010	nyce1	162	95.48	95.48	9.56	9.56	1.01	0.99
2011	nyce1	162	95.78	95.81	9.41	9.36	1.08	0.99
2012	nyce1	164	99.38	99.49	9.24	9.45	1.16	0.99
2013	nyce1	115	98.9	99.2	9.13	8.83	1.32	0.98
2014	nyce1	83	99.89	99.84	7.7	7.65	1.37	0.97
2015	nyce1	71	98.34	98.38	9.07	8.92	1.28	0.98
2016	nyce1	69	100.12	100.57	8.9	7.7	4.54	0.75
2017	nyce1	63	100.35	99.59	7.82	6.71	4.38	0.73
2018	nyce1	52	101.13	102.27	7.76	6.91	5.17	0.55
2019	nyce1	47	102.85	101.83	8.14	5.85	4.55	0.64
2020	nyce1	44	101.61	103.27	8.19	6.94	4.8	0.64
2009	nycs1	33	102.61	102.42	13.17	13.39	1.52	0.99
2010	nycs1	38	99.66	100.53	13.78	13.6	1.34	0.99
2011	nycs1	38	102.11	102.63	10.81	10.35	1.68	0.98
2012	nycs1	49	101.94	101.8	14.07	14.24	1.57	0.99
2013	nycs1	38	101.63	101.34	11.53	11.44	1.66	0.98
2014	nycs1	27	98.74	99.44	13.19	13.31	2.48	0.98
2015	nycs1	30	98.8	99.3	13.37	13.2	2.63	0.97
2016	nycs1	26	103.81	102.92	13.92	10.0	7.65	0.69
2017	nycs1	28	99.25	99.68	11.14	8.38	9.07	0.4
2018	nycs1	27	104.85	103.44	11.85	7.62	7.04	0.7

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2019	nycs1	23	102.22	101.65	13.01	7.63	8.83	0.58
2020	nycs1	19	101.32	100.32	8.47	6.74	7.21	0.35
2009	nysb2	156	97.12	96.91	8.3	8.2	1.04	0.99
2010	nysb2	163	99.37	98.93	8.84	8.84	1.25	0.98
2011	nysb2	166	97.96	97.41	7.79	7.68	1.39	0.98
2012	nysb2	167	99.22	99.14	7.68	7.87	1.31	0.98
2013	nysb2	120	100.84	100.62	7.93	7.48	1.46	0.98
2014	nysb2	84	99.26	99.37	7.8	7.85	1.77	0.96
2015	nysb2	71	98.48	98.39	8.37	9.32	2.17	0.96
2016	nysb2	70	99.31	99.76	8.56	6.4	5.16	0.62
2017	nysb2	66	98.74	99.42	7.58	5.94	4.35	0.67
2018	nysb2	51	99.06	99.49	7.6	6.56	4.55	0.66
2019	nysb2	38	98.5	100.37	9.37	5.06	7.03	0.41
2009	nyce2	153	93.9	93.95	9.76	9.56	0.66	1.0
2010	nyce2	162	97.08	97.01	9.24	9.15	0.79	0.99
2011	nyce2	165	97.92	97.87	8.65	8.43	0.85	0.99
2012	nyce2	164	100.21	100.26	7.99	8.07	1.1	0.98
2013	nyce2	115	99.59	99.69	7.43	7.25	1.0	0.98
2014	nyce2	83	100.53	100.39	5.72	5.7	1.16	0.96
2015	nyce2	71	100.14	100.13	7.99	7.81	1.11	0.98
2016	nyce2	69	100.96	101.25	7.51	5.78	4.67	0.58
2017	nyce2	64	100.38	100.34	6.18	5.99	3.28	0.78
2018	nyce2	47	100.81	102.26	5.85	5.26	4.51	0.46
2019	nyce2	36	102.44	102.42	5.89	5.95	3.86	0.61
2009	nycs2	36	100.0	99.94	12.78	12.69	1.28	0.99
2010	nycs2	39	97.92	98.59	9.77	9.6	1.13	0.99
2011	nycs2	42	100.76	101.19	11.17	11.55	1.43	0.99
2012	nycs2	49	100.53	99.88	10.28	10.68	1.8	0.98
2013	nycs2	40	101.6	101.28	10.0	9.98	1.48	0.98
2014	nycs2	28	96.79	96.5	12.49	12.77	2.0	0.98
2015	nycs2	31	97.74	98.71	11.37	10.85	2.19	0.97
2016	nycs2	27	101.07	99.33	14.09	9.21	8.11	0.69
2017	nycs2	26	101.69	100.15	8.9	7.07	7.62	0.41

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2018	nycs2	24	104.96	101.71	11.77	6.71	6.17	0.8
2019	nycs2	16	104.19	101.19	9.81	6.46	7.25	0.46

Table 37: Genetic trends (Single-step full dataset (f) vs single-step reduced dataset (r)) for nordic cows with genotype and phenotype

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2009	nysb1	434	93.85	94.0	6.82	6.96	1.85	0.94
2010	nysb1	3078	94.82	94.97	8.14	8.1	1.81	0.96
2011	nysb1	5293	94.9	95.07	7.41	7.36	1.79	0.95
2012	nysb1	5805	95.93	96.04	7.2	7.09	1.83	0.95
2013	nysb1	5697	96.7	96.83	6.8	6.63	1.87	0.94
2014	nysb1	6104	96.12	96.26	6.98	6.76	1.91	0.94
2015	nysb1	7387	98.37	98.26	6.6	6.36	2.02	0.92
2016	nysb1	10129	98.11	98.37	6.85	6.63	2.09	0.92
2017	nysb1	11461	97.99	97.89	6.93	6.72	2.23	0.92
2018	nysb1	12814	99.06	99.31	6.66	6.28	2.97	0.82
2019	nysb1	12267	98.82	98.92	6.39	6.14	3.42	0.76
2020	nysb1	13760	100.32	99.06	6.5	6.24	3.69	0.75
2021	nysb1	12945	100.14	99.94	7.17	6.42	4.28	0.68
2022	nysb1	12950	100.86	99.46	6.75	5.69	4.23	0.68
2023	nysb1	4140	101.46	99.55	6.35	5.39	4.43	0.63
2009	nyce1	389	90.77	90.86	8.9	8.85	1.34	0.98
2010	nyce1	2842	91.89	91.88	8.43	8.37	1.43	0.98
2011	nyce1	4739	91.97	91.94	7.85	7.81	1.44	0.97
2012	nyce1	5194	93.73	93.65	7.98	7.94	1.45	0.97
2013	nyce1	5117	94.2	94.19	7.54	7.46	1.51	0.97
2014	nyce1	5530	95.57	95.55	7.94	7.89	1.55	0.97
2015	nyce1	6713	96.67	96.74	7.77	7.73	1.62	0.96
2016	nyce1	9176	98.19	98.39	7.33	7.25	1.65	0.96
2017	nyce1	10341	97.3	97.18	7.01	6.82	1.76	0.95
2018	nyce1	11492	99.34	99.6	7.22	7.01	2.62	0.88
2019	nyce1	10885	99.35	99.18	7.0	6.63	3.05	0.84
2020	nyce1	12110	100.88	101.16	6.92	6.86	3.1	0.82
2021	nyce1	11330	101.02	100.68	6.79	6.24	3.33	0.79

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2022	nyce1	11347	101.95	101.0	6.4	6.08	3.1	0.81
2023	nyce1	3602	102.06	101.44	6.4	6.17	3.18	0.8
2009	nycs1	85	104.22	104.12	11.12	10.97	1.92	0.98
2010	nycs1	435	99.93	99.81	9.93	9.88	1.85	0.97
2011	nycs1	738	103.98	103.92	9.77	9.45	1.86	0.97
2012	nycs1	916	101.86	102.2	10.99	10.92	1.95	0.97
2013	nycs1	1167	101.11	101.3	10.28	9.99	2.0	0.97
2014	nycs1	1249	101.68	101.89	9.61	9.41	1.94	0.97
2015	nycs1	1514	102.14	102.16	10.72	10.45	2.15	0.97
2016	nycs1	1864	100.5	100.43	10.22	9.91	2.33	0.96
2017	nycs1	2496	101.8	102.09	9.37	9.05	2.49	0.94
2018	nycs1	2679	100.51	99.39	10.49	8.99	4.11	0.85
2019	nycs1	2582	101.29	101.26	9.42	7.43	5.08	0.74
2020	nycs1	3138	100.93	100.21	8.88	7.21	5.23	0.69
2021	nycs1	2649	103.68	102.09	8.58	6.72	4.77	0.74
2022	nycs1	2559	98.59	100.02	8.64	6.06	5.57	0.63
2023	nycs1	935	102.38	100.28	7.92	5.86	5.4	0.61
2009	nysb2	415	95.92	95.53	7.44	7.42	1.53	0.97
2010	nysb2	2824	96.77	96.44	7.64	7.54	1.49	0.97
2011	nysb2	4441	97.04	96.75	6.94	6.83	1.57	0.96
2012	nysb2	4638	97.95	97.63	6.9	6.86	1.59	0.96
2013	nysb2	4414	99.03	98.81	6.47	6.42	1.66	0.95
2014	nysb2	4476	97.98	97.8	6.71	6.63	1.73	0.94
2015	nysb2	5807	99.23	99.2	6.57	6.48	1.78	0.94
2016	nysb2	7538	98.93	98.98	6.62	6.49	1.88	0.93
2017	nysb2	8639	98.79	98.77	6.47	6.39	1.94	0.92
2018	nysb2	9443	99.1	99.31	6.49	6.15	2.87	0.82
2019	nysb2	9019	98.82	99.97	6.26	5.61	3.37	0.75
2020	nysb2	9775	98.93	99.43	6.2	6.02	3.3	0.76
2021	nysb2	7635	99.28	100.21	6.14	5.69	3.33	0.75
2022	nysb2	2436	99.83	100.07	6.2	5.43	3.58	0.71
2009	nyce2	397	91.66	91.64	9.27	9.13	1.14	0.99
2010	nyce2	2649	92.48	92.43	7.74	7.67	1.13	0.98

BYR	trait	n	m_f	m_r	s_f	s_r	mean_diff	cor
2011	nyce2	4108	93.11	93.07	7.13	7.07	1.15	0.98
2012	nyce2	4252	94.94	94.81	7.39	7.33	1.14	0.98
2013	nyce2	4147	95.5	95.44	6.97	6.92	1.2	0.97
2014	nyce2	4154	96.52	96.49	6.88	6.91	1.24	0.97
2015	nyce2	5423	97.72	97.67	6.47	6.52	1.34	0.96
2016	nyce2	7013	98.56	98.54	6.38	6.35	1.33	0.96
2017	nyce2	7924	98.6	98.46	6.14	6.07	1.41	0.95
2018	nyce2	8586	100.02	100.14	6.5	6.1	2.55	0.84
2019	nyce2	8074	99.8	100.41	5.81	5.59	2.73	0.8
2020	nyce2	8761	100.32	101.24	5.9	6.18	3.05	0.8
2021	nyce2	6700	100.37	101.43	5.54	5.65	3.17	0.75
2022	nyce2	2113	100.97	100.79	5.32	5.41	2.81	0.78
2009	nycs2	86	104.93	104.8	10.85	10.65	1.36	0.99
2010	nycs2	432	101.68	101.64	8.82	8.88	1.32	0.98
2011	nycs2	594	104.49	104.47	8.71	8.77	1.4	0.98
2012	nycs2	774	101.74	101.88	9.96	9.97	1.46	0.98
2013	nycs2	911	102.5	102.59	8.55	8.4	1.52	0.97
2014	nycs2	979	101.67	101.64	8.25	8.18	1.58	0.97
2015	nycs2	1191	101.85	101.87	9.31	9.19	1.69	0.97
2016	nycs2	1402	101.05	100.81	9.31	9.2	1.95	0.96
2017	nycs2	1824	101.12	101.25	8.6	8.36	2.04	0.95
2018	nycs2	1981	100.77	99.66	9.23	7.54	3.6	0.86
2019	nycs2	1892	101.77	100.66	8.59	6.93	5.12	0.71
2020	nycs2	1904	102.98	101.17	7.98	6.3	4.36	0.77
2021	nycs2	1349	104.07	101.87	7.4	5.7	4.39	0.73
2022	nycs2	545	100.11	100.58	8.43	6.09	4.62	0.73

Test of Foreign information

As part of the Interbull collaboration, we recieve breeding values from foreign (non-nordic) bulls, along with a reliability. These has to be converted to a pseudo-phenotype to be included in the evaluation. Here, we test that the calculated breeding values for these bulls are similar to the original ones from Interbull in mean and standard deviation.

Table 38: Means and standard deviations for foreign bulls in new single-step (ss), new EBV (ebv) and original interbull breeding value (bv), as well as correlation between single-step breeding value and Interbull breeding value. Calving ease first lactation.

BYR	n	m_ss	m_ebv	m_bv	s_ss	s_ebv	s_bv	cor_ss	cor_ebv
2009	126	84.71	86.4	86.53	8.13	7.25	6.91	0.88	0.97
2010	104	87.14	88.32	88.67	10.47	10.35	8.95	0.9	0.97
2011	115	88.36	88.9	88.96	9.54	9.38	8.21	0.9	0.95
2012	117	84.02	85.03	86.0	8.17	8.54	7.56	0.85	0.92
2013	83	81.63	82.59	82.98	10.71	10.23	9.54	0.92	0.96
2014	16	90.12	91.06	90.92	10.76	10.27	8.11	0.95	0.97
2015	16	88.44	89.06	86.62	12.74	12.34	10.76	0.94	0.99
2016	34	86.94	87.74	86.93	9.31	9.02	8.89	0.88	0.96
2017	16	89.12	91.0	89.23	9.26	10.35	8.4	0.89	0.96
2018	26	93.0	95.04	91.76	11.05	10.23	8.4	0.91	0.98
2019	45	91.2	92.89	90.17	10.65	9.91	8.91	0.88	0.98
2020	12	91.75	92.33	88.83	12.69	12.23	11.67	0.95	0.99

Correlations

Here, we give correlation tables and tables of differences between the relevant evaluations. We test that we didn't change the model by comparing our new model without genomic information to the breeding values of the traditional pedigree-based model and expect very high correlations for tested animals. We test the change by incorporating genomic information, compared to a non-genomic evaluation, and expect to see some changes even in tested animals, but not too large.

Table 39: Correlations between current EBV and new EBV for Nordic AI bulls with > 30 offspring in nysb1

BYR	n	cor7	cor8	cor9	cor10	cor11	cor12
2009	156	0.99	0.996	0.996	0.992	0.996	0.998
2010	163	0.995	0.998	0.995	0.991	0.997	0.998
2011	166	0.989	0.993	0.995	0.986	0.992	0.996
2012	167	0.991	0.996	0.998	0.988	0.995	0.999
2013	117	0.989	0.995	0.998	0.986	0.994	0.999
2014	84	0.992	0.991	0.998	0.984	0.988	0.999
2015	71	0.992	0.997	0.999	0.992	0.996	0.999
2016	70	0.994	0.997	0.999	0.989	0.992	0.999
2017	66	0.991	0.994	0.999	0.976	0.99	0.999
2018	52	0.985	0.995	0.999	0.978	0.991	1.0
2019	48	0.995	0.997	0.999	0.993	0.992	0.999
2020	45	0.993	0.997	0.999	0.988	0.994	0.999

Table 40: Table of differences between current EBV and new EBV for Nordic AI bulls with > 30 offspring in nysb1 born after 2015

dif	dif7	dif8	dif9	dif10	dif11	dif12
−6.0	0	0	0	1	0	0
−5.0	2	0	0	1	0	0
−4.0	4	0	0	3	2	0
−3.0	9	3	0	8	4	0
−2.0	18	7	1	11	19	0
−1.0	55	58	89	44	61	50
0.0	56	107	190	91	84	231
1.0	60	78	7	70	61	6
2.0	35	23	0	46	39	0
3.0	29	9	0	11	14	0
4.0	11	2	0	1	3	0
5.0	2	0	0	0	0	0
6.0	4	0	0	0	0	0
7.0	1	0	0	0	0	0
8.0	1	0	0	0	0	0

Table 41: Correlations between current EBV and new Single-step for AI bulls with > 30 offspring in nysb1

BYR	n	cor7	cor8	cor9	cor10	cor11	cor12
2009	156	0.918	0.963	0.912	0.915	0.961	0.913
2010	163	0.936	0.94	0.912	0.925	0.938	0.897
2011	166	0.927	0.935	0.894	0.891	0.939	0.912
2012	167	0.915	0.945	0.928	0.909	0.917	0.912
2013	117	0.901	0.952	0.917	0.895	0.935	0.905
2014	84	0.954	0.944	0.93	0.924	0.924	0.947
2015	71	0.954	0.973	0.945	0.926	0.958	0.919
2016	70	0.955	0.963	0.914	0.93	0.949	0.928
2017	66	0.948	0.957	0.94	0.932	0.919	0.917
2018	52	0.93	0.956	0.945	0.867	0.915	0.943
2019	48	0.968	0.957	0.933	0.906	0.851	0.919
2020	45	0.944	0.93	0.9	0.804	0.806	0.884

Table 42: Table of differences between current EBV and new Single-step for AI bulls with > 30 offspring in nysb1 born after 2015

dif	dif7	dif8	dif9	dif10	dif11	dif12
−14.0	0	0	0	0	0	1
−13.0	0	0	0	0	0	0
−12.0	0	0	1	0	0	0
−11.0	0	0	1	0	0	0
−10.0	0	0	0	1	2	1
−9.0	1	1	3	5	1	0
−8.0	1	4	1	2	4	2
−7.0	3	4	7	5	8	3
−6.0	5	10	5	3	3	8
−5.0	9	6	11	9	8	10
−4.0	10	9	18	12	8	12
−3.0	13	25	25	15	18	25
−2.0	32	32	27	27	33	33
−1.0	33	45	26	23	44	29
0.0	41	46	31	37	34	36
1.0	46	45	27	36	35	23
2.0	34	30	29	32	33	23
3.0	18	11	21	32	23	30
4.0	17	5	15	21	16	16
5.0	8	12	10	10	4	11
6.0	7	1	8	8	7	10
7.0	4	1	8	3	2	7
8.0	3	0	5	2	4	4
9.0	0	0	3	2	0	2
10.0	1	0	2	0	0	1
11.0	0	0	0	2	0	0
12.0	0	0	1	0	0	0
13.0	1	0	1	0	0	0
14.0	0	0	0	0	0	0
15.0	0	0	1	0	0	0

Table 43: Correlations between current two-step and new Single-step (combined calving index) for genotyped AI bulls born after 2009 with > 30 offspring

BYR	n	cor
2009	156	0.916
2010	163	0.911
2011	166	0.919
2012	167	0.881
2013	117	0.905
2014	84	0.921
2015	71	0.946
2016	69	0.916
2017	66	0.903
2018	52	0.887
2019	48	0.88
2020	45	0.832

Table 44: Table of differences between current two-step and new Single-step (combined calving index) for genotyped AI bulls with > 30 offspring born after 2015

dif	dif14
−12.0	1
−11.0	0
−10.0	1
−9.0	1
−8.0	3
−7.0	4
−6.0	5
−5.0	5
−4.0	8
−3.0	13
−2.0	19
−1.0	24
0.0	32
1.0	30
2.0	19
3.0	27
4.0	23
5.0	14

dif	dif14
6.0	20
7.0	11
8.0	8
9.0	6
10.0	4
11.0	2
12.0	4
13.0	1
14.0	0
15.0	1

Table 45: Correlations between current two-step and new Single-step for genotyped nordic bulls with no offspring born after 2020

BYR	n	cor
2020	2781	0.717
2021	2778	0.724
2022	2603	0.698
2023	2316	0.635
2024	2205	0.587
2025	763	0.618

Table 46: Table of differences between current two-step and new Single-step for genotyped nordic bulls born after 2020 with no offspring

dif	dif14
−18.0	1
−17.0	2
−16.0	4
−15.0	11
−14.0	5
−13.0	14
−12.0	18
−11.0	32
−10.0	78
−9.0	80
−8.0	150

dif	dif14
−7.0	221
−6.0	269
−5.0	361
−4.0	461
−3.0	516
−2.0	616
−1.0	774
0.0	804
1.0	838
2.0	851
3.0	772
4.0	690
5.0	699
6.0	616
7.0	473
8.0	401
9.0	325
10.0	219
11.0	174
12.0	110
13.0	72
14.0	41
15.0	23
16.0	16
17.0	12
18.0	6
19.0	9
20.0	0
21.0	0
22.0	0
23.0	1

Legarra-Reverter test

The Legarra-Reverter test is a test for bias in evaluations. We perform two calculations of breeding values, one with all information available and one where offspring of sires born after 2018 has their records removed. Then we perform a linear regression on genotyped, nordic bulls, who has no data in the reduced dataset and with more than 30 offspring in the full dataset. We also require that their sires are not in the focal group, so we remove bulls whose father meets the same criteria.

The slope of the regression indicates the bias, with a slope of one meaning no bias, a slope less than one indicating that the estimated values of unproven animals are too extreme, and a slope higher than one indicating that the estimated breeding values of unproven animals are too conservative.

As can be seen, we have some issues with the Legarra-Reverter test. We're looking into it.

Table 47: Legarra-Reverter scores
Singlestep:

trait	b1	rsquare	n
nysb1	0.749	0.338	285
nyce1	0.794	0.457	279
nycs1	0.839	0.358	103
nysb2	0.809	0.365	226
nyce2	0.707	0.39	216
nycs2	0.925	0.396	79

EBV:

trait	b1	rsquare	n
nysb1	0.946	0.233	285
nyce1	0.764	0.197	279
nycs1	0.944	0.287	103
nysb2	0.8	0.173	226
nyce2	0.74	0.176	216
nycs2	0.729	0.207	79

Mendelian sampling

The mendelian sampling of an animals is its deviation of its breeding values from the expected breeding value, which is the average of its parents breeding values. Some mendelian samling is expected on the individual level (this is what enables breeding), but across all animals we expect it to be close to zero. Otherwise, this indicates a bias in the set of animals in the evaluation, which violates the unbiasedness of the BLUP model. We conclude that the mendelian sampling is generally close to 0.

Table 48: Average mendelian sampling by birth year. Animals are only included if they are genotyped, their sire has > 30 offspring in nysb1 and their dam is genotyped.

BYR	m7	m8	m9	m10	m11	m12
2010	−0.43	−0.165	0.146	−0.203	−0.159	0.173
2011	−0.032	0.121	−0.014	0.086	0.079	−0.037
2012	0.023	0.057	0.067	−0.055	0.013	0.078
2013	−0.061	0.024	−0.057	−0.059	0.018	−0.031
2014	0.074	−0.003	0.03	0.151	−0.017	0.025
2015	0.212	0.134	0.087	0.265	0.15	0.089
2016	0.099	0.127	0.128	0.155	0.067	0.123
2017	0.102	0.049	−0.047	0.216	0.101	−0.036
2018	0.154	0.094	−0.001	0.288	0.083	0.054
2019	0.164	0.167	−0.028	0.138	0.148	−0.019
2020	0.234	0.058	0.05	0.24	0.14	0.021
2021	0.17	0.044	0.07	0.237	0.084	0.047
2022	0.036	0.035	−0.026	0.126	0.034	0.019
2023	0.037	−0.076	−0.006	0.01	0.024	−0.023
2024	0.064	−0.082	−0.059	−0.062	0.04	−0.079

Table 49: Average mendelian sampling by birth year. Animals are only included if they are not genotyped, their sire has > 30 offspring and their dam isn't genotyped.

BYR	m7	m8	m9	m10	m11	m12
2001	1.096	−0.423	−0.058	1.942	−0.5	−0.115
2002	−1.929	−0.804	0.304	−2.232	−0.714	0.321
2003	−0.37	2.537	−0.519	−0.574	1.481	−0.741
2004	1.955	3.727	0.864	3.409	3.182	−0.318
2005	0.273	2.136	0.682	1.955	1.136	0.545
2006	−1.75	−1.75	−0.083	−1.917	−1.083	−0.5
2007	−0.5	−0.036	0.893	−2.0	−1.893	0.821
2008	−0.5	−1.545	0.773	−1.5	−1.773	0.773
2009	−5.1	−0.6	1.4	−2.8	1.1	0.1
2010	3.031	0.938	−1.156	1.312	0.344	−1.219
2011	0.071	1.714	−0.786	−2.714	0.929	−0.571
2012	1.0	−0.75	1.125	1.375	0.5	0.875
2013	2.188	1.0	−0.562	1.375	1.875	−0.562

BYR	m7	m8	m9	m10	m11	m12
2014	−5.9	−4.2	1.4	−3.5	−5.0	1.3
2015	−0.5	−1.3	0.9	0.5	0.2	0.5
2016	−1.0	−2.3	−0.45	−2.15	−1.5	−0.4
2017	−0.571	1.714	0.357	−1.143	2.214	−1.429
2018	1.286	2.286	−0.286	0.5	0.357	−0.286
2019	2.375	3.375	−1.625	0.375	0.625	−2.375

Reliabilities

Table 50: Comparison of reliabilities between single-step (ss), new EBV (ebv) and current official evaluation (cur) for nordic AI bulls with > 30 offspring and correlation between single-step and current evaluation.

BYR	trait	n	rel_ss	rel_ebv	rel_cur	s_rel_ss	s_rel_ebv	s_rel_cur	cor
2009	nysb1	156	85.21	75.12	80.13	4.57	7.86	6.87	0.93
2010	nysb1	163	84.07	72.11	77.51	4.86	8.34	7.17	0.92
2011	nysb1	166	85.3	73.82	79.35	5.43	9.79	8.51	0.92
2012	nysb1	167	86.14	73.44	78.76	6.22	10.59	9.27	0.92
2013	nysb1	117	87.73	75.29	80.06	7.19	12.74	11.5	0.93
2014	nysb1	84	91.49	80.1	84.27	6.35	12.25	11.07	0.94
2015	nysb1	71	93.56	82.31	85.89	5.22	11.35	10.22	0.93
2016	nysb1	70	93.24	80.97	85.36	5.3	11.32	9.87	0.93
2017	nysb1	66	93.23	80.44	84.98	5.68	12.61	10.48	0.94
2018	nysb1	52	93.26	80.14	85.16	5.49	12.11	9.81	0.9
2019	nysb1	48	94.22	80.76	85.96	5.26	12.51	10.14	0.96
2020	nysb1	45	93.5	79.48	87.43	4.83	11.2	8.99	0.93
2021	nysb1	6	89.25	71.39	87.18	2.68	6.92	10.12	0.95
2009	nyce1	155	85.0	75.24	78.99	4.61	7.76	7.57	0.9
2010	nyce1	162	83.84	72.21	76.03	4.92	8.27	8.02	0.88
2011	nyce1	162	85.18	74.19	78.35	5.49	9.62	9.36	0.87
2012	nyce1	164	86.06	73.77	77.5	6.24	10.4	10.17	0.89
2013	nyce1	115	87.69	75.6	78.64	7.25	12.63	12.42	0.93
2014	nyce1	83	91.51	80.41	83.67	6.28	11.99	11.67	0.92
2015	nyce1	71	93.44	82.31	84.88	5.32	11.35	11.12	0.92
2016	nyce1	69	93.32	81.3	84.86	5.12	11.06	10.72	0.94
2017	nyce1	63	93.66	81.47	85.08	5.26	11.95	10.9	0.92

BYR	trait	n	rel_ss	rel_ebv	rel_cur	s_rel_ss	s_rel_ebv	s_rel_cur	cor
2018	nyce1	52	93.12	80.14	84.24	5.6	12.11	11.01	0.86
2019	nyce1	47	94.42	81.38	85.98	4.94	11.88	10.32	0.94
2020	nyce1	44	93.63	79.94	87.58	4.63	10.9	9.42	0.9
2021	nyce1	6	89.02	71.39	86.42	2.74	6.92	11.38	0.94
2009	nycs1	33	84.63	73.27	−99.0	8.8	14.29	0.0	NaN
2010	nycs1	38	83.83	70.6	−99.0	8.55	14.57	0.0	NaN
2011	nycs1	38	86.05	73.54	−99.0	9.35	16.84	0.0	NaN
2012	nycs1	49	87.71	75.65	−99.0	8.94	15.63	0.0	NaN
2013	nycs1	38	91.2	82.56	−99.0	9.11	15.66	0.0	NaN
2014	nycs1	27	94.77	87.45	−99.0	6.59	13.16	0.0	NaN
2015	nycs1	30	95.64	87.84	−99.0	4.99	11.2	0.0	NaN
2016	nycs1	26	95.85	87.55	−99.0	4.48	10.79	0.0	NaN
2017	nycs1	28	95.57	86.98	−99.0	5.14	11.86	0.0	NaN
2018	nycs1	27	95.86	86.35	−99.0	4.48	11.7	0.0	NaN
2019	nycs1	23	97.0	88.7	−99.0	3.3	8.65	0.0	NaN
2020	nycs1	19	96.53	87.19	−99.0	2.67	7.98	0.0	NaN
2009	nysb2	156	85.57	75.09	75.0	4.51	7.91	7.18	0.94
2010	nysb2	163	84.48	72.11	72.46	4.75	8.34	7.65	0.93
2011	nysb2	166	85.69	73.82	74.42	5.28	9.79	9.15	0.94
2012	nysb2	167	86.53	73.45	74.21	6.02	10.58	9.85	0.93
2013	nysb2	120	87.77	74.76	75.56	7.17	13.04	12.33	0.95
2014	nysb2	84	91.73	80.1	80.45	6.17	12.25	11.87	0.94
2015	nysb2	71	93.74	82.31	81.81	5.08	11.35	11.28	0.93
2016	nysb2	70	93.43	80.97	80.56	5.16	11.32	11.13	0.92
2017	nysb2	66	93.42	80.44	80.45	5.52	12.61	11.81	0.92
2018	nysb2	51	93.71	80.43	81.49	5.08	12.03	10.72	0.93
2019	nysb2	38	96.36	85.29	84.53	3.03	8.97	8.46	0.92
2020	nysb2	3	98.96	94.23	92.6	0.4	2.32	4.91	0.83
2009	nyce2	153	85.55	75.43	74.98	4.42	7.62	7.0	0.86
2010	nyce2	162	84.32	72.21	72.18	4.78	8.27	7.81	0.89
2011	nyce2	165	85.54	73.92	74.94	5.32	9.73	8.84	0.92
2012	nyce2	164	86.46	73.71	74.94	6.08	10.46	9.89	0.92
2013	nyce2	115	88.1	75.64	76.71	7.0	12.58	12.28	0.93

BYR	trait	n	rel_ss	rel_ebv	rel_cur	s_rel_ss	s_rel_ebv	s_rel_cur	cor
2014	nyce2	83	91.78	80.41	81.68	6.08	11.99	11.93	0.93
2015	nyce2	71	93.65	82.31	82.56	5.15	11.35	11.62	0.91
2016	nyce2	69	93.54	81.3	82.07	4.96	11.06	11.25	0.92
2017	nyce2	64	93.58	81.04	82.41	5.49	12.32	11.51	0.9
2018	nyce2	47	94.24	81.75	84.15	4.85	11.6	10.34	0.91
2019	nyce2	36	96.61	86.21	86.88	2.8	8.27	7.5	0.94
2020	nyce2	2	99.03	94.59	93.5	0.53	3.16	5.8	1.0
2009	nycs2	36	84.92	73.78	−99.0	8.28	13.56	0.0	NaN
2010	nycs2	39	84.27	71.26	−99.0	8.72	14.96	0.0	NaN
2011	nycs2	42	85.82	73.16	−99.0	9.25	16.72	0.0	NaN
2012	nycs2	49	87.86	75.7	−99.0	8.78	15.57	0.0	NaN
2013	nycs2	40	91.25	82.26	−99.0	8.67	15.28	0.0	NaN
2014	nycs2	28	94.86	87.55	−99.0	6.44	12.92	0.0	NaN
2015	nycs2	31	95.61	87.75	−99.0	4.89	11.03	0.0	NaN
2016	nycs2	27	95.36	86.57	−99.0	5.13	11.75	0.0	NaN
2017	nycs2	26	96.36	88.27	−99.0	4.0	10.7	0.0	NaN
2018	nycs2	24	96.91	88.86	−99.0	3.32	9.68	0.0	NaN
2019	nycs2	16	97.79	90.91	−99.0	2.16	6.55	0.0	NaN
2020	nycs2	1	98.49	92.35	−99.0	NaN	NaN	NaN	NaN

Table 51: Comparison of reliabilities between single-step and current official evaluation (two-step) for nordic genotyped bulls with no offspring

BYR	n	ss_rel	two_rel	s_ss_rel	s_two_rel	cor
2020	2761	44.549	64.635	0.99	2.771	0.557317
2021	2728	44.56	63.478	1.121	3.242	0.624348
2022	2529	44.562	61.878	1.036	2.824	0.585501
2023	2258	43.96	58.599	1.332	3.523	0.745737
2024	2143	43.358	56.441	1.305	2.931	0.656121
2025	762	42.906	55.658	1.429	2.826	0.623872