Supplemental Table 1. Descriptive statistics on the effect of different editing steps. DMI = Dry matter intake, CV%=Coefficient of variation, SD=Standard deviation, CFIT=Cattle Feed InTake, DCRC=Danish Cattle Research Center.

	n DMI records	n Milk records	n cows DMI	n cows DMI
Input data	493,442	292,534	12,300	12,699
Mahalanobis distance outlier detection	491,465	289,996	12,285	12,682
Weekly correction of CV% and SD	482,058	286,539	12,250	12,669
Requirement of milk test-day in 1st parity and DMI in 4th parity for CFIT and 1st parity for DCRC	457,985	243,543	11,302	11,302
Minimum 2 milk and/or 4 DMI records per parity	453,052	230,238	10,546	10,549
Input genetic analysis	443,362	214,257	10,054	

Supplemental Table 2. Descriptive statistics for number of cows and lactations in the different herd IDs. DCRC=Danish Cattle Research Center.

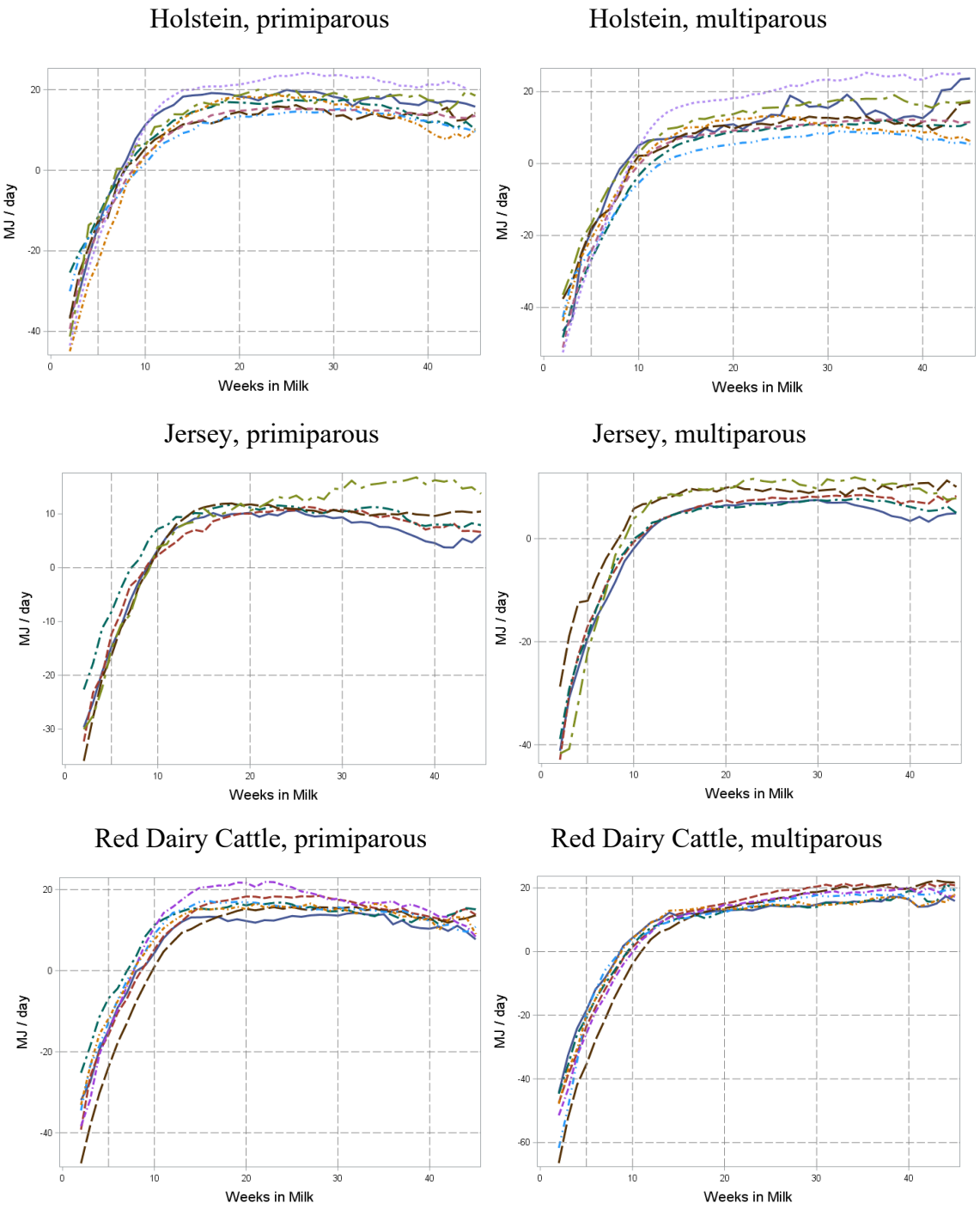
Farm ID	Holstein		Farm ID	Jersey		Farm ID	Red Dairy Cattle	
	Cows	Lactations		Cows	Lactations		Cows	Lactations
8	575	847	1	423	747	2	247	425
10	390	654	3	294	525	5	543	930
14	325	554	4	508	840	6	393	679
17	610	1,018	9	395	603	7	486	784
18	521	893	12	448	771	13	582	934
19	950	1,615				16	616	1,049
20	502	867				21	368	618
DCRC	878	1,403						
Sum	4,751	7,851		2,068	3,486		3,235	5,419
N genotyped cows	3,870			1,910			2,976	

Supplemental Table 3. Lactation sum results from model M8 of Jersey cows for primi- and multiparous lactations. Posterior mean and standard deviation are presented for heritabilities on the diagonal and genetic correlations on off diagonal. Lactation wise additive and phenotypic variances are presented in the top rows for all traits. DMI=Dry matter intake, $gRFI_{EB}$=genetic residual feed intake using EB_{body} as energy sink, $gRFI_{\Delta BW}$=genetic residual feed intake using ΔBW as energy sink, ECM=Energy corrected milk, BW=Body weight, EB_{body}=Energy balance from changes in body reserves, ΔBW=change in BW derived from BW, Primi=Primiparous lactation, Multi=Multiparous lactations.

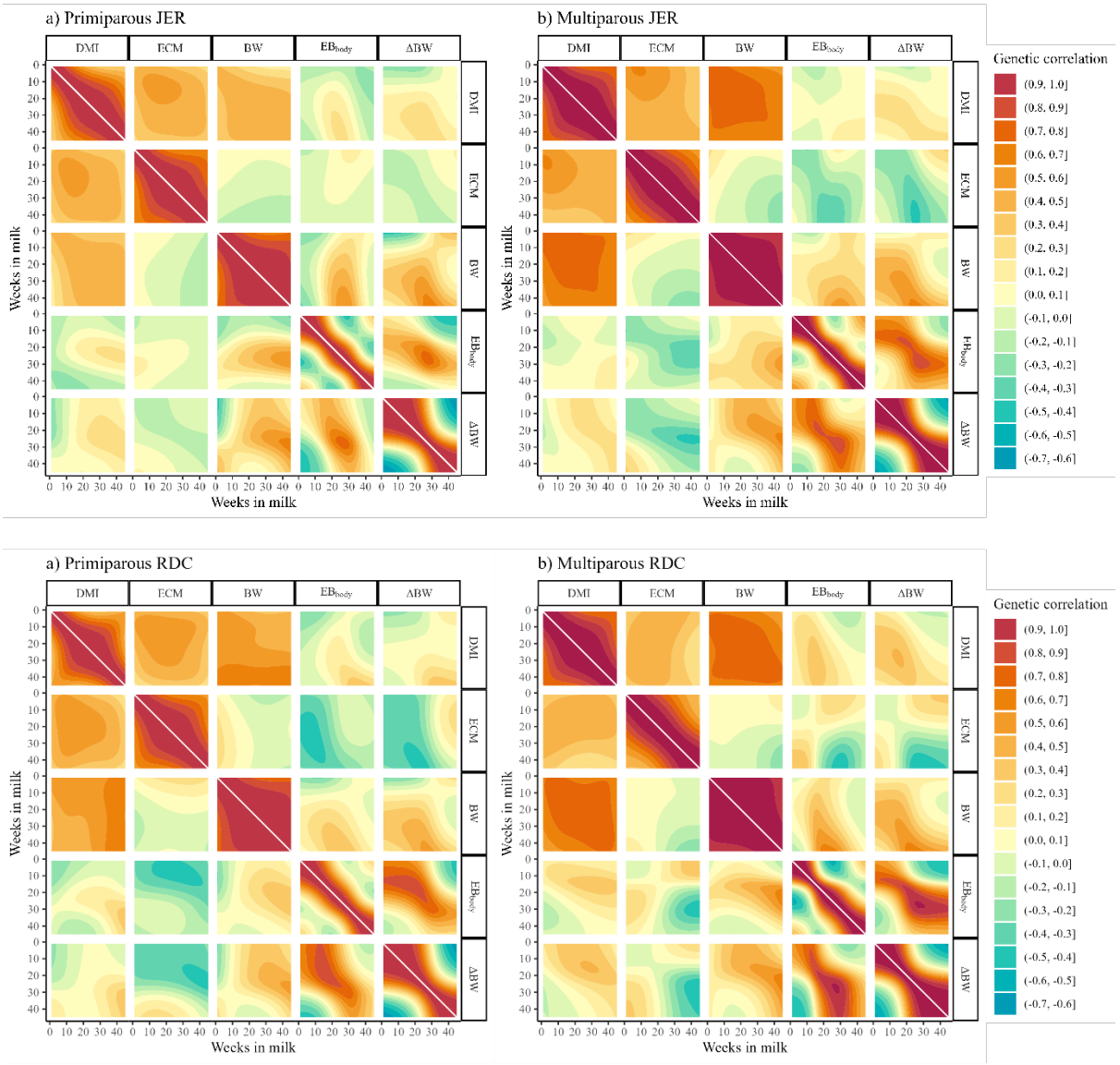
	DMI Primi	**$gRFI_{EB}$ Primi**	**$gRFI_{\Delta BW}$ Primi**	**ECM Primi**	**BW Primi**	**EB_{body} Primi**	**ΔBW Primi**	**DMI Multi**	**$gRFI_{EB}$ Multi**	**$gRFI_{\Delta BW}$ Multi**	**ECM Multi**	**BW Multi**	**EB_{body} Multi**	**ΔBW Multi**
σ_A^2	4,804 (796)	2,027 (401)	2,124 (417)	13,877 (1,810)	764,465 (102,340)	27,331 (7,152)	331 (62)	5,532 (786)	1,490 (314)	1,462 (311)	23,654 (3,119)	1,101,075 (127,618)	23,420 (4942)	249 (46)
σ_P^2	9437 (302)	4438 (153)	4430 (152)	34668 (985)	4,657,536 (134,413)	218,494 (8,307)	2,709 (76)	11,103 (300)	7,420 (248)	7,448 (248)	58,320 (1,636)	6,329,812 (181,165)	138,503 (5,141)	4,276 (63)
DMI, Primi	**0.45 (0.06)**													
$gRFI_{EB}$, Primi	0.65 (0.06)	**0.36 (0.06)**												
$gRFI_{\Delta BW}$, Primi	0.67 (0.06)	0.96 (0.04)	**0.38 (0.06)**											
ECM, Primi	0.52 (0.08)	0.00 (0.00)	0.00 (0.00)	**0.51 (0.05)**										
BW, Primi	0.48 (0.08)	0.00 (0.00)	0.00 (0.00)	-0.06 (0.09)	**0.56 (0.06)**									
EB_{body}, Primi	-0.12 (0.16)	0.00 (0.00)	-0.19 (0.16)	-0.02 (0.14)	0.05 (0.13)	**0.29 (0.07)**								
ΔBW, Primi	0.15 (0.12)	0.07 (0.13)	0.00 (0.00)	-0.11 (0.11)	0.37 (0.1)	0.25 (0.15)	**0.24 (0.04)**							
DMI, Multi	0.70 (0.06)	0.23 (0.09)	0.22 (0.08)	0.43 (0.08)	0.59 (0.07)	0.02 (0.15)	0.26 (0.11)	**0.45 (0.05)**						
$gRFI_{EB}$, Multi	0.30 (0.10)	0.40 (0.12)	0.39 (0.12)	0.06 (0.08)	-0.01 (0.07)	-0.01 (0.16)	-0.08 (0.12)	0.52 (0.05)	**0.2 (0.04)**					
$gRFI_{\Delta BW}$, Multi	0.32 (0.09)	0.42 (0.11)	0.41 (0.11)	0.05 (0.08)	0.02 (0.07)	-0.01 (0.16)	-0.08 (0.13)	0.51 (0.05)	0.97 (0.03)	**0.2 (0.04)**				
ECM, Multi	0.46 (0.09)	0.07 (0.08)	0.09 (0.08)	0.82 (0.04)	-0.10 (0.10)	-0.1 (0.14)	-0.05 (0.11)	0.41 (0.08)	0.00 (0.00)	0.00 (0.00)	**0.48 (0.05)**			
BW, Multi	0.38 (0.08)	-0.03 (0.07)	-0.05 (0.07)	-0.07 (0.09)	0.87 (0.03)	0.11 (0.13)	0.44 (0.09)	0.65 (0.06)	0.00 (0.00)	0.00 (0.00)	-0.18 (0.09)	**0.58 (0.05)**		
EB_{body}, Multi	-0.18 (0.13)	-0.04 (0.15)	-0.03 (0.14)	-0.26 (0.12)	-0.03 (0.12)	-0.06 (0.18)	0.01 (0.15)	-0.11 (0.13)	0.00 (0.00)	-0.08 (0.12)	-0.40 (0.10)	0.15 (0.11)	**0.38 (0.07)**	
ΔBW, Multi	-0.21 (0.13)	-0.12 (0.14)	-0.14 (0.14)	-0.32 (0.11)	0.11 (0.12)	0.09 (0.18)	0.15 (0.14)	0.03 (0.12)	0.13 (0.11)	0.00 (0.00)	-0.46 (0.10)	0.29 (0.10)	0.61 (0.09)	**0.15 (0.03)**

Supplemental Table 4. Lactation sum results from model M8 of Red Dairy Cattle cows for primi- and multiparous lactations. Posterior mean and standard deviation are presented for heritabilities on the diagonal and genetic correlations on off diagonal. Lactation wise additive and phenotypic variances are presented in the top rows for all traits. DMI=Dry matter intake, $gRFI_{EB}$=genetic residual feed intake using EB_{body} as energy sink, $gRFI_{\Delta BW}$=genetic residual feed intake using ΔBW as energy sink, ECM=Energy corrected milk, BW=Body weight, EB_{body}=Energy balance from changes in body reserves, ΔBW=change in BW derived from BW, Primi=Primiparous lactation, Multi=Multiparous lactations.

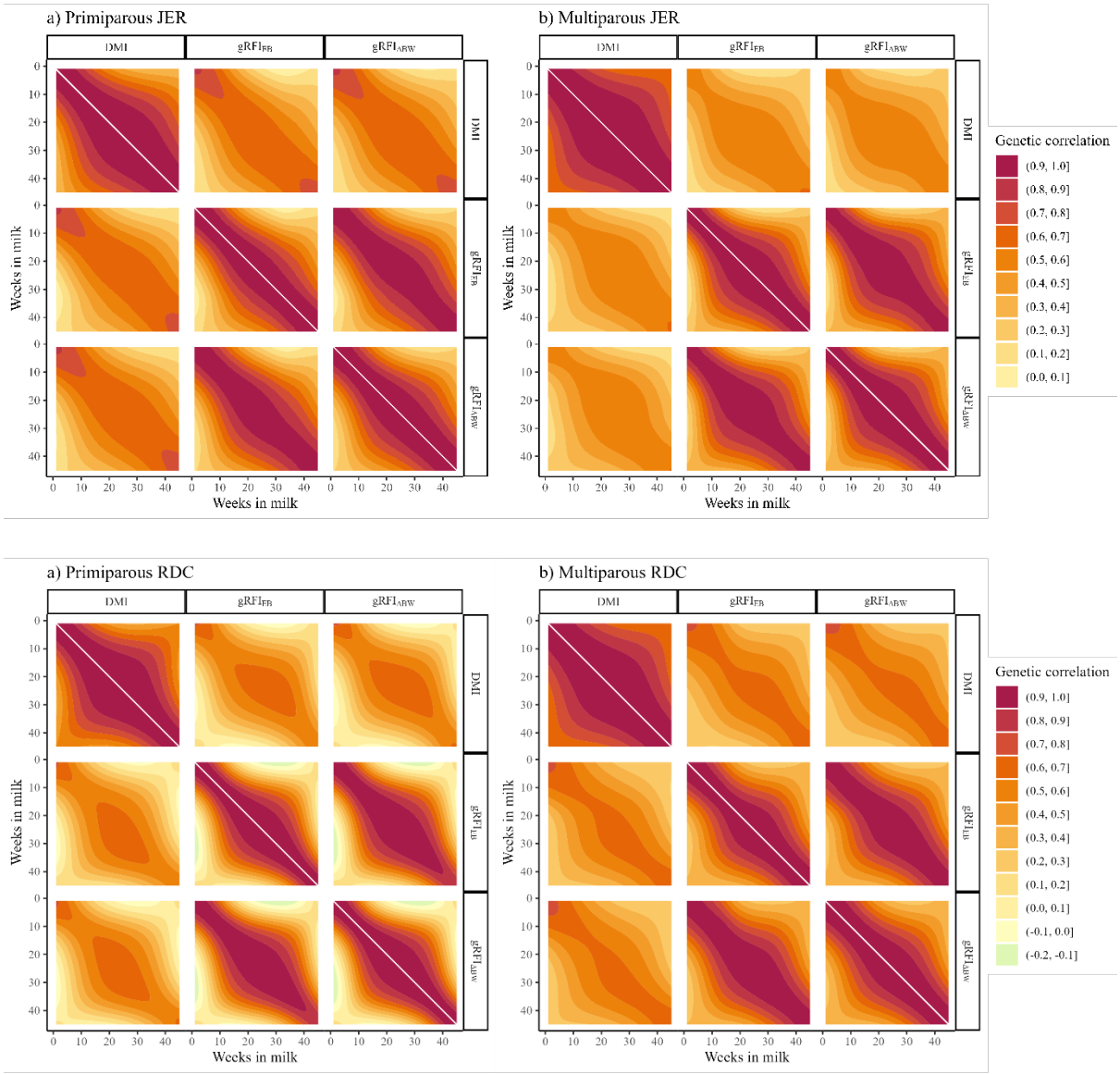
	DMI Primi	**$gRFI_{EB}$ Primi**	**$gRFI_{\Delta BW}$ Primi**	**ECM Primi**	**BW Primi**	**EB_{body} Primi**	**ΔBW Primi**	**DMI Multi**	**$gRFI_{EB}$ Multi**	**$gRFI_{\Delta BW}$ Multi**	**ECM Multi**	**BW Multi**	**EB_{body} Multi**	**ΔBW Multi**
σ_A^2	4,053 (475)	1,110 (240)	1,126 (236)	14,491 (1,690)	3,267,593 (279,083)	41,997 (8,630)	1,019 (161)	4,058 (464)	1,338 (204)	1,363 (199)	21,683 (2,895)	4,103,852 (323,017)	33,092 (7,969)	805 (161)
σ_P^2	7,660 (286)	3,368 (152)	3,384 (154)	29,453 (1,010)	4,982,943 (174,685)	120,268 (6,068)	2,891 (104)	9,514 (319)	5,764 (249)	5,774 (247)	57,428 (1925)	6,731,692 (217,751)	151,129 (6,524)	4,070 (102)
DMI, Primi	**0.53 (0.05)**													
$gRFI_{EB}$, Primi	0.52 (0.05)	**0.33 (0.06)**												
$gRFI_{\Delta BW}$, Primi	0.53 (0.05)	0.98 (0.02)	**0.33 (0.06)**											
ECM, Primi	0.56 (0.06)	0.00 (0.00)	0.00 (0.00)	**0.49 (0.05)**										
BW, Primi	0.63 (0.05)	0.00 (0.00)	0.00 (0.00)	0.01 (0.07)	**0.65 (0.04)**									
EB_{body}, Primi	-0.05 (0.11)	0.00 (0.00)	0.06 (0.11)	-0.41 (0.10)	0.15 (0.10)	**0.35 (0.06)**								
ΔBW, Primi	0.05 (0.10)	0.02 (0.09)	0.00 (0.00)	-0.37 (0.09)	0.30 (0.09)	0.75 (0.07)	**0.35 (0.05)**							
DMI, Multi	0.84 (0.04)	0.31 (0.07)	0.32 (0.07)	0.45 (0.07)	0.64 (0.05)	0.08 (0.11)	0.17 (0.09)	**0.43 (0.04)**						
$gRFI_{EB}$, Multi	0.41 (0.07)	0.57 (0.09)	0.59 (0.09)	0.20 (0.07)	-0.03 (0.04)	0.05 (0.12)	0.00 (0.11)	0.57 (0.04)	**0.23 (0.03)**					
$gRFI_{\Delta BW}$, Multi	0.41 (0.07)	0.57 (0.09)	0.59 (0.09)	0.20 (0.07)	-0.03 (0.04)	0.05 (0.12)	-0.01 (0.11)	0.58 (0.04)	0.98 (0.02)	**0.24 (0.03)**				
ECM, Multi	0.33 (0.08)	-0.10 (0.08)	-0.10 (0.08)	0.74 (0.05)	-0.06 (0.08)	-0.27 (0.12)	-0.24 (0.1)	0.35 (0.08)	0.00 (0.00)	0.00 (0.00)	**0.38 (0.04)**			
BW, Multi	0.60 (0.06)	0.02 (0.05)	0.02 (0.05)	-0.03 (0.07)	0.94 (0.01)	0.24 (0.09)	0.40 (0.08)	0.66 (0.05)	0.00 (0.00)	0.00 (0.00)	-0.15 (0.08)	**0.61 (0.03)**		
EB_{body}, Multi	-0.04 (0.13)	0.06 (0.15)	0.06 (0.15)	-0.04 (0.13)	-0.08 (0.12)	0.02 (0.16)	-0.04 (0.13)	0.00 (0.13)	0.00 (0.00)	0.09 (0.11)	-0.22 (0.13)	0.02 (0.11)	**0.22 (0.05)**	
ΔBW, Multi	0.10 (0.11)	0.06 (0.14)	0.05 (0.14)	-0.04 (0.12)	0.13 (0.09)	0.08 (0.15)	0.15 (0.12)	0.11 (0.11)	0.00 (0.09)	0.00 (0.00)	-0.29 (0.11)	0.27 (0.08)	0.56 (0.11)	**0.20 (0.04)**



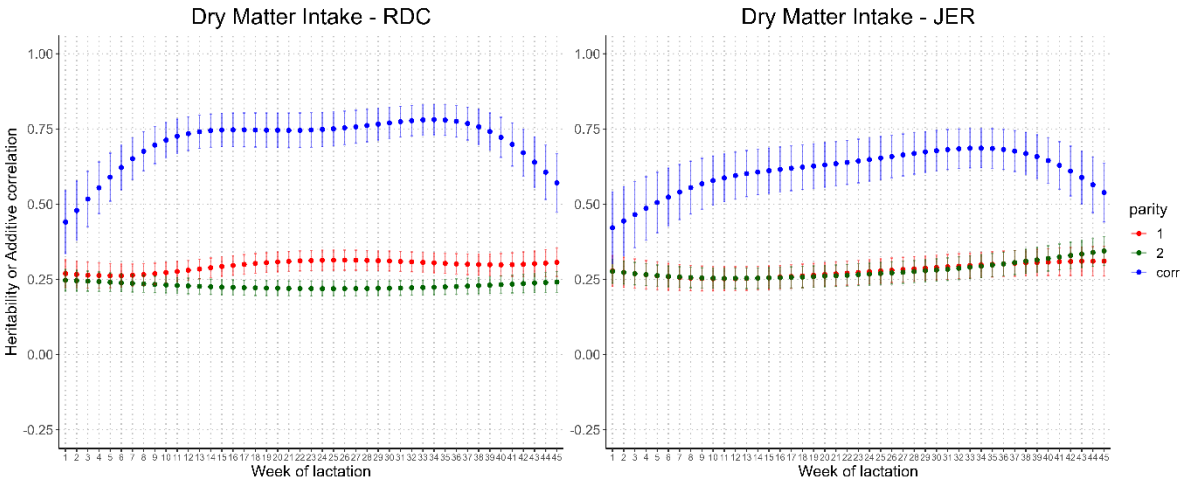
Supplemental Figure 1. Lactation curves of EB_{body} MJ/day for the different breeds and parity groups. Color and line pattern represents different herds.

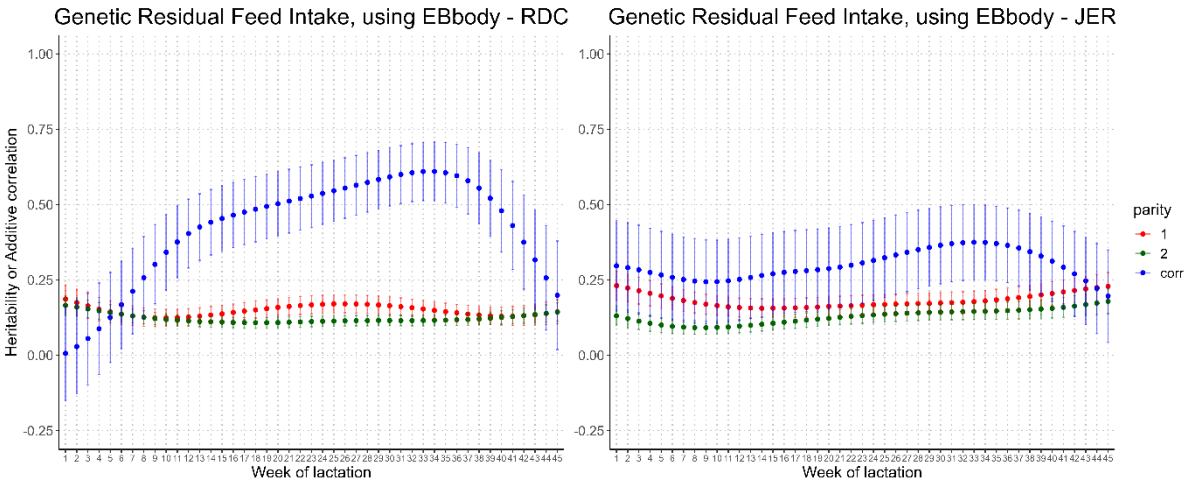


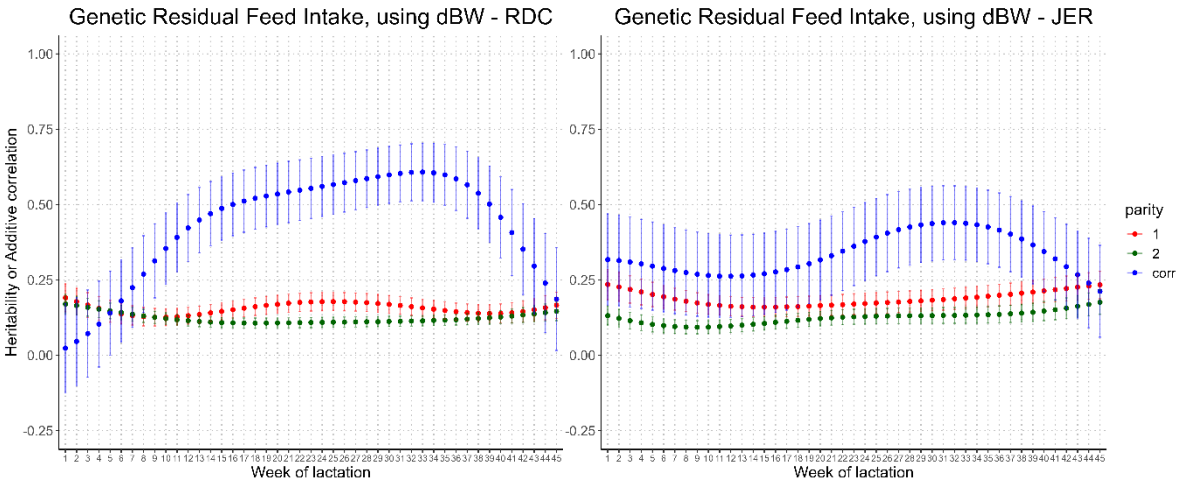
Supplemental Figure 2. Contour plot of posterior means for weekly additive genetic correlations in primiparous (a) and multiparous (b) JER and RDC cows for the traits DMI, ECM, BW, EB_{body} and ΔBW. Posterior standard deviations were across breeds for the additive genetic correlations for 10% quantile 0.03, median 0.09-0.12 and for 90% quantile 0.12-0.15. DMI=Dry matter intake, ECM=Energy corrected milk, BW=Body weight, EB_{body}=Energy balance from changes in body reserves, ΔBW=Changes in body weight, JER=Jersey, RDC=Red Dairy Cattle.

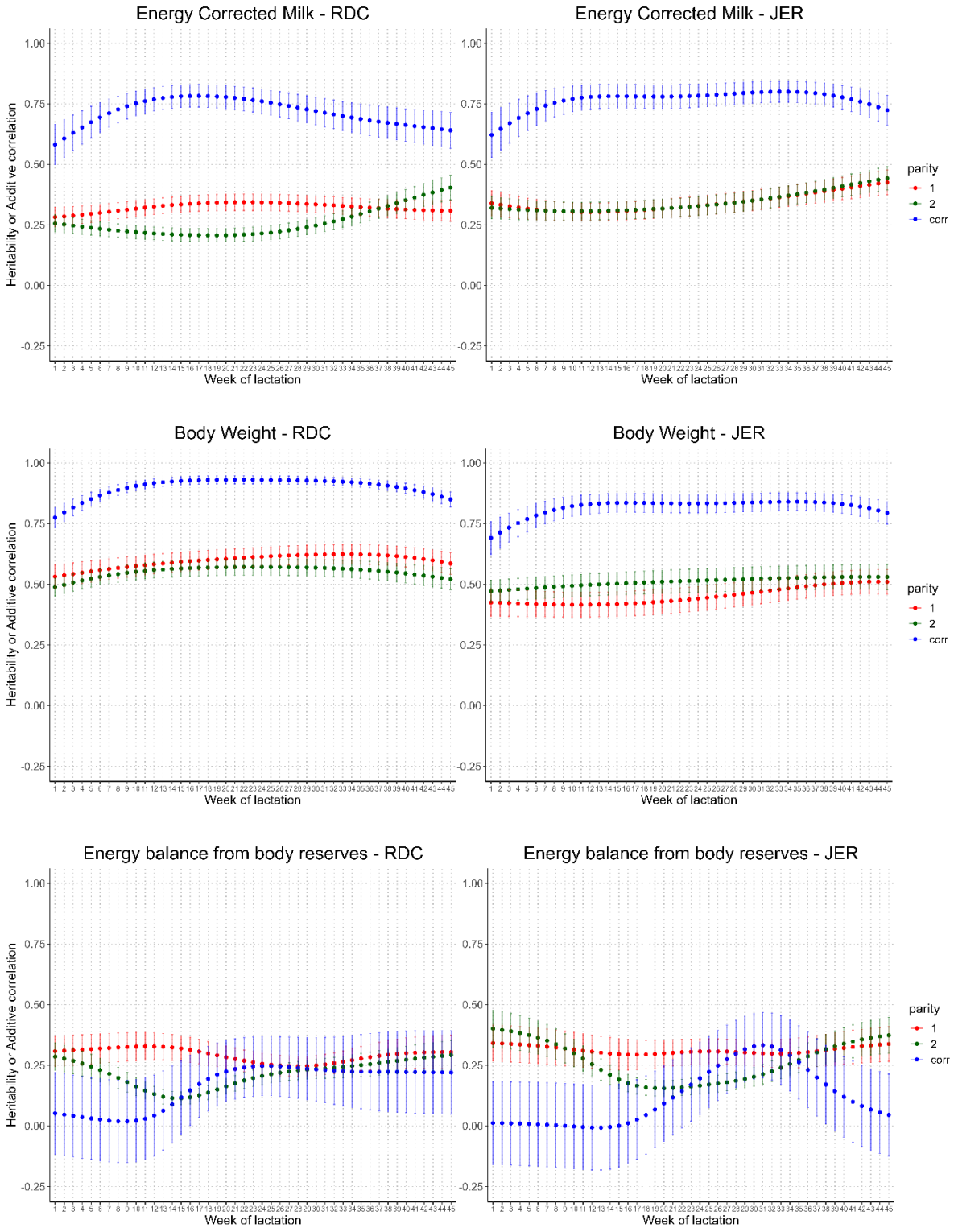


Supplemental Figure 3. Contour plot of posterior means for weekly additive genetic correlations in primiparous (a) and multiparous (b) JER and RDC cows for the traits DMI, $gRFI_{EB}$, $gRFI_{\Delta BW}$. Posterior standard deviation were across breeds for the additive genetic correlations at 10% quantile in the range 0.03, median 0.09-0.12 and for 90% quantile 0.12-0.15 across breeds. DMI=Dry matter intake, $gRFI_{EB}$=genetic residual feed intake using EB_{body} as energy sink, $gRFI_{\Delta BW}$=genetic residual feed intake using ΔBW, JER=Jersey, RDC=Red Dairy Cattle.


Dry Matter Intake - RDC
Dry Matter Intake - JER
Heritability or Additive correlation
Week of lactation
parity
1
2
corr


Genetic Residual Feed Intake, using EBbody - RDC
Genetic Residual Feed Intake, using EBbody - JER
Heritability or Additive correlation
Week of lactation
parity
1
2
corr


Genetic Residual Feed Intake, using dBW - RDC
Genetic Residual Feed Intake, using dBW - JER
Heritability or Additive correlation
Week of lactation
parity
1
2
corr



Supplemental Figure 4. Posterior means of heritabilities for the two parity groups (red dots represent primiparous; green dots represent multiparous) and the additive genetic correlation (blue dots) between the parity groups for the traits DMI, $gRFI_{EB}$, $gRFI_{\Delta BW}$, ECM, BW and EB_{body}. Posterior standard deviation of the estimates are represented as errorbars in the plots. DMI=Dry matter intake, $gRFI_{EB}$=genetic residual feed intake using EB_{body} as energy sink, $gRFI_{\Delta BW}$=genetic residual feed intake using ΔBW, ECM=Energy corrected milk, BW=Body weight, EB_{body}=Energy balance from changes in body reserves, JER=Jersey, RDC=Red Dairy Cattle.