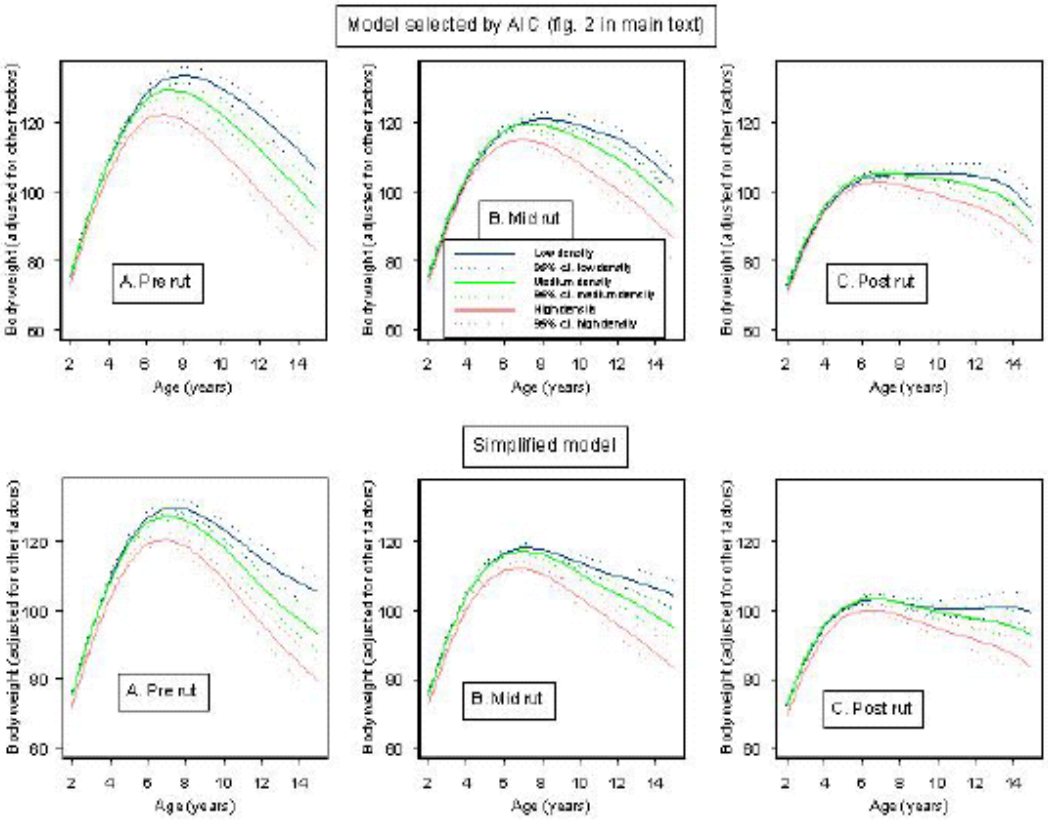
These are electronic appendices to the paper by Yoccoz *et al*. 2002 Age- and density-dependent reproductive effort in male red deer. *Proc. R. Soc. Lond*. B **269**, 1523-1528.

Electronic appendices are refereed with the text. However, no attempt has been made to impose a uniform editorial style on the electronic appendices.

Electronic appendix Fig. 1. The relationship between body weight and age presented at different stages of the rut and for 3 different densities; results of the (first row) selected model by AIC (equivalent to fig. 2 in main text) and (second row) a simplified model. The predicted values of weight are plotted, all variables other than age, density and date of culling being taken as equal to their mean value. The curve corresponds to population P3.



Electronic appendix Table 1. Sample sizes for age classes of male red deer at the west coast of Norway included in the analysis.

Age (yr)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Sum
n	5524	4096	2142	875	500	311	154	127	69	40	29	15	9	8	6	3	1	3	1	13913

Supplemental Table 2. Test statistics from additive models presented in Figure 1 of the main text.

Fig in main text	Age	$df_{splines}$	df	F	P
1A	1	1 versus 2	1	17.171	< 0.001
1B	2	3 versus 4	1	4.597	0.032
1C	3	3 versus 4	1	6.879	0.009
1D	4	2 versus 3	1	5.498	0.019
1E	5-7	3 versus 4	1	4.564	0.033
1F	>7	2 versus 3	1	3.216	0.074

Electronic appendix Table 3. Results from analysis done by removing or adding terms to the model selected by AIC (for which the absolute AIC value is given). The reference level for the factor "Population" is "P1". The terms of interest (**bolded**) are (1) the interaction between Age*Density, which demonstrates that the effect of density on body weight is age-dependent, (2) the interaction between Age^2*Density, which shows that the curvature for body weight against male age is dependent on population density (i.e., curves do not have the same shape), and (3) the interaction (Date of culling)*Density* Age, which shows that weight loss during rut is dependent on male age and population density. P-values are indicative as they are derived from a model selected using AIC.

		df	ΔAIC	*F*	*P*
	Model selected by AIC		(-54920.86)		
removing term	Density*(Date of culling)	1	0.86	2.84	0.0917
	Age^3*Density	1	1.22	3.20	0.0736
	NAO^2	1	2.91	4.88	0.0272
	Density*$(Date\ of\ culling)^2$	1	3.66	5.62	0.0178
	Age^2*(Date of culling)	1	4.20	6.16	0.0131
	Age^2*Density	**1**	**5.82**	**7.77**	**0.0053**
	NAO^4	1	6.39	8.34	0.0039
	Age*Density	**1**	**8.25**	**10.19**	**0.0014**
	Age^3*Population	4	9.62	4.38	0.0015
	Population*NAO	4	9.90	4.45	0.0014
	(Date of culling)*Density*Age	**1**	**10.04**	**11.97**	**0.0005**
	Age^3*(Date of culling)	1	10.24	12.17	0.0005
	Diversity of altitudes	1	10.94	12.87	0.0003
	Population*$Density^4$	5	11.35	4.25	0.0007
	Age^4*(Date of culling)	1	11.93	13.85	0.0002
	Population*$Density^3$	5	13.37	4.65	0.0003
	Age^2*Population	4	14.33	5.55	0.0002
	Population*$Density^5$	5	14.78	4.93	0.0002
	NAO^3	1	17.40	19.30	0.0000
	Population*$Density^2$	5	20.07	5.99	0.0000
	Cumulative density of the past 10 years	1	24.38	26.25	0.0000
	Age*Population	4	28.88	9.18	0.0000
	$(Date\ of\ culling)^3$	1	36.08	37.91	0.0000
	Proportion of high altitude habitat	1	54.28	56.06	0.0000
	Diversity of aspects	1	134.83	136.72	0.0000
	Distance from the coast	1	214.54	216.98	0.0000
adding term	$(Date\ of\ culling)^4$	1	-0.09	0.15	0.1493
	Population*NAO^2	4	0.50	1.87	0.1133
	Age^4*$(Date\ of\ culling)^2$	1	1.18	0.82	0.3650
	$Density^6$	1	1.72	0.28	0.5982
	Density*Age^4	1	1.96	0.04	0.8401
	Age^5	1	2.00	0.01	0.9307
	NAO^5	1	2.00	0.00	0.9984
	Population*Age^4	4	3.51	1.12	0.3466

Electronic appendix Table 4. Results from removing/adding terms to a simplified model (obtained by removing the most complex interactions terms, as well as some high-order terms, such as NAO_4). The reference level for the factor "Population" is "P1". See Supplementary Table 3 for an explanation of the terms of interest (**bolded**).

	df	ΔAIC	*F*	*P*
Simple model		(-54877.57)		
NAO^2	1	2.14	4.13	0.0422
(Date of culling)*Density*Age	**1**	**5.32**	**7.28**	**0.0070**
Age^2*(Date of culling)	1	6.84	8.80	0.0030
Age*Density	**1**	**7.61**	**9.57**	**0.0020**
Population*$Density^4$	5	9.77	3.94	0.0014
Age^3*(Date of culling)	1	12.93	14.87	0.0001
Age^2*Density	**1**	**13.13**	**15.06**	**0.0001**
Age^4*(Date of culling)	1	13.57	15.51	0.0001
Population*$Density^2$	5	14.98	4.98	0.0001
NAO^3	1	15.92	17.85	0.0000
Diversity of altitudes	1	15.93	17.86	0.0000
Population*$(Density)^5$	5	15.93	5.17	0.0001
Population*$(Density)^3$	5	16.40	5.26	0.0001
Cumulative density of the past 10 years	1	16.73	18.65	0.0000
NAO	1	28.03	29.92	0.0000
$(Date\ of\ culling)^3$	1	29.68	31.56	0.0000
$(Age)^2$*Population	4	43.29	12.78	0.0000
Proportion of high altitude habitat	1	62.80	64.64	0.0000
Age*Population	4	78.83	21.67	0.0000
$(Date\ of\ culling)^2$	1	124.68	126.64	0.0000
Diversity of aspects	1	140.17	142.21	0.0000
Distance from the coast	1	218.19	220.87	0.0000

Electronic appendix Table 5. Parameter estimates of the simplified linear model (least square estimates). The reason for presenting estimates from the simplified model is that estimates of higher order interactions (which were common in the model selected by AIC; see Supplementary table 3) are not readily interpretable. The reference level for the factor "Population" is "P1".

	Value	Std. Error
Intercept	1.57460	0.36110
Population(P2-P1)	-0.02130	0.00900
Population(P3-P1)	0.08910	0.00980
Population(P4-P1)	0.08870	0.04010
Population(P5-P1)	-0.00480	0.01760
Density	-0.03470	0.01020
$Density^2$	-0.03470	0.00860
$Density^3$	0.03100	0.01070
$Density^4$	0.01080	0.00330
$Density^5$	-0.00920	0.00300
NAO	0.00910	0.00170
Age	0.44460	0.00700
Age^2	-0.06180	0.00210
Age^3	0.00360	0.00020
Age^4	-0.00010	0.00000
Cumulative density of the past 10 years	-0.00780	0.00180
(Date of culling)	0.00240	0.00650
$(Date\ of\ culling)^2$	-0.02240	0.00200
$(Date\ of\ culling)^3$	0.00760	0.00140
Diversity of altitudes	0.04020	0.00950
Proportion of high altitude habitat	-0.15600	0.01940
Diversity of aspects	2.07090	0.17360
NAO^2	0.00060	0.00030
NAO^3	-0.00050	0.00010
Distance from the coast	0.07610	0.00510
(Date of culling)*Density*Age	0.00200	0.00070
Population(P2)*Density	0.01040	0.01220
Population(P3)*Density	0.03230	0.01410
Population(P4)*Density	-0.17820	0.21950
Population(P5)*Density	-0.03290	0.06700
Population(P2)*$Density^2$	0.04440	0.01700
Population(P3)*$Density^2$	0.01510	0.01230
Population(P4)*$Density^2$	1.76920	1.59660
Population(P5)*$Density^2$	-0.22750	0.14640
Population(P2)*$Density^3$	-0.04330	0.01550
Population(P3)*$Density^3$	-0.06620	0.01660
Population(P4)*$Density^3$	7.49070	5.16490
Population(P5)*$Density^3$	0.48130	0.19800
Population(P2)*$Density^4$	-0.03130	0.00900
Population(P3)*$Density^4$	-0.01010	0.00410
Population(P4)*$Density^4$	6.34390	4.21470
Population(P5)*$Density^4$	-0.19040	0.45530
Population(P2)*$Density^5$	0.02100	0.00550
Population(P3)*$Density^5$	0.01570	0.00380
Population(P4)*$Density^5$	1.53480	1.00780
Population(P5)*$Density^5$	-0.01780	0.20600
Density*Age^2	-0.00080	0.00020
(Date of culling)*Age	-0.00530	0.00680
Population(P2)*Age	0.01590	0.00440
Population(P3)*Age	-0.00490	0.00470
Population(P4)*Age	-0.02670	0.01930
Population(P5)*Age	-0.04280	0.00620
Population(P2)*Age^2	-0.00090	0.00050
Population(P3)*Age^2	0.00010	0.00050
Population(P4)*Age^2	0.00140	0.00160
Population(P5)*Age^2	0.00340	0.00060
Density*Age	0.00620	0.00200
Age^2*(Date of culling)	-0.00640	0.00220
Age^3*(Date of culling)	0.00090	0.00020
Age^4*(Date of culling)	0.00000	0.00000
Density*(Date of culling)	-0.00270	0.00200