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Appendix

Table 1. The description and nominal values of the parameters used in the model.

Parameter	Description	Wapiti nominal value	Irish elk nominal value
FGB	Max daily forage rate in kg dry mass eaten per kg body mass	0.023	0.023
MC	Metabolizable energy coefficient	0.82	0.82
RLBWL	Proportion of total energy from protein	0.3	0.3
RFATL	Proportion of total energy from fat	1 – RLBWL	1 – RLBWL
BM_i	Initial body mass in kg	179	460
GE	Gross energy of forage in kJ kg^{-1}	18410	18410
ME	Metabolizable energy needed per kg body mass	418	376
FATEN	kJ kg^{-1} of fat catabolized	39330	39330
GWP	Mass of water per unit mass of protein	4.0	4.0
LEAN	kJ kg^{-1} of protein	22175	22175
BM_{lean}	Body mass in kg without fat reserves	179	460
BM_{fetus}	Body mass of offspring (kg)	16	32.6
S	Avg. daily movement (km)	4.6	13.9
M	kJ l^{-1} of milk	6267.2	8848.5
MP	Maximum amount of milk produced day^{-1} (l)	3.87	4.0
a	Mean of FB function	0.82	0.6
b	Amplitude of FB function	0.24	0.39
c	Translation of FB function determined by length of non-growing season	0.5 (under Allerød conditions)	0.5 (under Allerød conditions)

FGB: this parameter is an average of maximum daily dry matter (kg) intake per body mass (kg) for the adult females of extant deer species: white-tailed deer (Long et al. 1965, Short 1975, Short et al. 1969), American moose (Renecker and Hudson 1985, 1986), Pere David's deer and red deer (Loudon and Brinklow 1992). Multiple estimates for single species were averaged before analysis. FGB appears to be a constant and unrelated to body mass ($r^2 = 0.007$, $p = 0.92$, $n = 4$). This is similar to the value of 0.025 used by Turner et al. (1994) for both wapiti and bison.

MC: a value of 0.82 was used by Turner et al. (1994) for the model of wapiti and American bison.

RLBWL: this value was estimated from mule deer (Hobbes 1989), but is assumed to be conserved throughout ungulate evolution (Turner et al. 1994), and is thus used unchanged for Irish elk and wapiti.

BM_i: we started the simulation at the beginning of the growing season; therefore we assumed the female was at her lean body mass.

GE: this value was estimated for the vegetation that wapiti forage on in Colorado (Hobbs et al. 1981, Turner et al. 1994).

ME: Turner et al. (1994) calibrated a value of 418 for wapiti and 376 for American bison for their model. Because of similar sizes of female American bison and Irish elk and to maintain consistency for calibrated values, the bison value was used for Irish elk.

FATEN, GWP, LEAN: all of these value were estimated from mule deer (Torbit et al. 1985, Turner et al. 1994), but are assumed to be conserved throughout ungulate evolution, and were thus used unchanged for Irish elk.

BM_{lean}: the lean body mass of female Irish elk was taken from Geist (1998). That of wapiti was taken from Turner et al. (1994).

BM_{fetus}: following Geist (1987), the body mass of offspring was calculated as $g_{neonate}/kal_{maternal\ BMR} = 0.395(g_{antler\ mass})/(kg_{male\ body\ mass})^{1.35} + 1.784$. The formula for maternal basal metabolic rate, $BMR = 69.806(kg_{body\ mass})^{0.7505}$, was calculated with the cervid data in Table A1-3 in Geist (1998). As most of the data (48/55) had extremely low residuals ($r^2 = 0.9997$) and seemed to have been calculated, the outliers were ignored for the purpose of finding the BMR equation. The average *Cervus elaphus canadensis* neonatal body mass from Table A2 in Geist (1998) was used for wapiti.

S: the average daily movement of *Tragelaphus derbiansis* (Carbone et al. 2005) was used for the model as eland are similar in size, weight, and cursorial adaptations to the Irish elk (Geist 1998). To determine average daily movement of wapiti, we combined feeding and non-feeding movement rates (4 m min^{-1} and 10 m min^{-1} respectively) used by Turner et al. (1994) with an average yearly time spent moving and feeding (11.5% and 51.2% respectively) for wapiti (Green and Bear 1990).

M: the energy cost of producing milk for an Irish elk was estimated following Geist's (1987) method for determining the percent milk solids by weight: $\%_{milk\ solids} = 1.675(g_{antler\ mass})/(kg_{male\ body\ mass})^{1.35} + 15.01$. The relative amounts of the major components of milk solids (fat, protein and lactose) were estimated by taking the averages for large (>50 kg) cervids (Table A6 in Geist 1998). Multiple measurements for a species were averaged so each species would be represented only once. Data for colostrum were not used. The resulting percent contents of milk fat, protein and lactose were combined with their respective densities and energy contents (Walstra and Jenness 1984) to estimate the energy content of Irish elk milk. The composition of wapiti milk was taken from Robbins et al. (1981) and combined with the energy densities from Walstra and Jenness (1984). We assumed a lactation efficiency of 80% for both species (Mauget et al. 1999).

MP: the maximum production of 4 litre day^{-1} for Irish elk was based conservatively on the reported estimate of 4.5 litre day^{-1} (Kingdon 1982) for the similarly sized and cursorial eland, an ecological analog of the Irish elk (Geist 1998). The maximum milk production for wapiti was taken from Robbins et al. (1981).

a: we found an allometric relationship between 'a' and body mass in non-reproductive female cervids: white-tailed deer (Long et al. 1965, Short 1975, Short et al. 1969), American moose (Renecker and Hudson 1985, 1986), black-tailed deer (Nordan 1968), Pere David's deer and red deer (Loudon and Brinklow 1992) ($a = 1.6788(kg_{body\ mass})^{-0.1792}$; $r^2 = 0.94$, $p = 0.007$, $n = 5$). Multiple estimates for single species were averaged before analysis. We assumed the same relationship for reproductive females and based the difference between the reproductive and non-reproductive curve intercepts on female red deer differences (Heydon et al. 1992). For simplicity, only the reproductive values were used in the model. Fat body weights were used in this analysis.

b: we found an allometric relationship between 'b' and body mass in non-reproductive female cervids: white-tailed deer (Long et al. 1965, Short 1975, Short et al. 1969), American moose (Renecker and Hudson 1985, 1986), black-tailed deer (Nordan 1968), Pere David's deer and red deer (Loudon and Brinklow 1992) ($b = 0.0479(kg_{body\ mass})^{0.3496}$; $r^2 = 0.80$, $p = 0.04$, $n = 5$). Multiple estimates for single species were averaged before analysis. We assumed the same relationship for reproductive females and based the difference between the reproductive and non-reproductive curve intercepts on female red deer differences (Heydon et al. 1992). For simplicity, only the reproductive values were used in the model. Fat body weights were used in this analysis.

c: this value was set so that the greatest intake of forage occurred when lactation (if it occurred) was most costly and vegetation was most digestible (Loudon and Brinklow 1992). This parameter therefore changed when the length of the non-growing season changed.

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