

The following supplement accompanies the article

Estimating the cost of growth in southern right whales from drone photogrammetry data and long-term sighting histories

Electronic supplementary material:

Table S1. Body length, volume and mass growth rates and energetic costs

Table S2. Mass and growth rates of different body tissues

Table S3. Energetic content and cost of growth of different body tissues

Figure S1. Effect of tissue specific lipid and protein concentration on energetic cost of growth

Figure S2. Relationship between protein and lipid concentration of different body tissues

Figure S3. Measured body lengths of southern right whales by reproductive class

Figure S4. Calf growth rates in body volume and length

Figure S5. von Bertalanffy growth curves fitted to southern right whale length-at-age data

Figure S6. Richards growth curves fitted to southern right whale length-at-age data

Figure S7. Logistic growth curves fitted to southern right whale length-at-age data

Figure S8. Gompertz growth curves fitted to southern right whale length-at-age data

Figure S9. Modified Gompertz growth curves fitted to southern right whale length-at-age data

Figure S10. Model parameter output from bootstrapping resampling of repeated measurements

Figure S11. Model parameter output from bootstrapping resampling of measurement errors

Table S1. Predicted mean body length, volume, mass, and energy content of southern right whales at different ages (D=days, Y=years), and associated daily growth rates in length, volume, mass, and energy (cost of growth). Estimates are based on an animal in average body condition (BC=0), and hence represents the structural growth (not including energy deposition) of whales. Ages denoted with an asterisk are extrapolations beyond the age range of the data set (assuming a longevity of ~80 years).

Age	Length (m)	Length growth (cm/day)	Volume (m ³)	Volume growth (liters/day)	Mass (kg)	Mass growth (kg/day)	Total energy content (GJ)	Total cost of growth (MJ/day)
D-0	4.66 (4.10-5.26)	11.95 (10.77-12.9)	1.69 (1.15-2.44)	134.15 (112.51-153.71)	1360 (924-1963)	108.00 (90.58-123.75)	26.60 (18.07-38.38)	2111.9 (1771.3-2419.9)
D-1	4.78 (4.23-5.37)	10.71 (9.82-11.37)	1.82 (1.26-2.59)	126.18 (105.04-145.72)	1468 (1014-2086)	101.59 (84.56-117.32)	28.71 (19.84-40.80)	1986.5 (1653.6-2294.1)
D-2	4.88 (4.34-5.46)	9.73 (9.04-10.19)	1.95 (1.37-2.74)	119.54 (98.96-138.89)	1570 (1099-2204)	96.24 (79.67-111.81)	30.70 (21.49-43.09)	1881.9 (1558.0-2186.5)
D-3	4.98 (4.44-5.55)	8.93 (8.39-9.25)	2.07 (1.46-2.88)	113.89 (93.9-132.95)	1666 (1179-2315)	91.69 (75.60-107.03)	32.58 (23.05-45.28)	1793.0 (1478.3-2093.0)
D-4	5.07 (4.53-5.64)	8.26 (7.83-8.48)	2.18 (1.56-3.01)	109.01 (89.6-127.73)	1758 (1254-2422)	87.76 (72.13-102.83)	34.37 (24.53-47.37)	1716.1 (1410.5-2010.8)
D-5	5.15 (4.62-5.72)	7.69 (7.34-7.85)	2.29 (1.65-3.14)	104.73 (85.87-123.09)	1845 (1326-2525)	84.31 (69.13-99.09)	36.09 (25.94-49.38)	1648.7 (1351.9-1937.7)
D-6	5.23 (4.70-5.79)	7.20 (6.92-7.31)	2.40 (1.73-3.26)	100.94 (82.61-118.92)	1930 (1396-2624)	81.26 (66.51-95.74)	37.74 (27.29-51.32)	1589.0 (1300.5-1872.2)
D-7	5.30 (4.77-5.86)	6.78 (6.55-6.84)	2.50 (1.82-3.38)	97.54 (79.71-115.17)	2011 (1462-2720)	78.53 (64.18-92.72)	39.32 (28.59-53.19)	1535.6 (1254.9-1813.0)
D-8	5.37 (4.84-5.93)	6.40 (6.22-6.44)	2.60 (1.90-3.49)	94.49 (77.12-111.75)	2090 (1526-2813)	76.07 (62.09-89.97)	40.86 (29.84-55.00)	1487.5 (1214.2-1759.2)
D-9	5.43 (4.90-5.99)	6.07 (5.92-6.09)	2.69 (1.97-3.61)	91.71 (74.79-108.62)	2166 (1588-2903)	73.84 (60.21-87.45)	42.35 (31.06-56.76)	1443.8 (1177.4-1710.0)
D-10	5.49 (4.96-6.05)	5.78 (5.65-5.77)	2.78 (2.05-3.71)	89.18 (72.67-105.75)	2239 (1649-2990)	71.80 (58.50-85.14)	43.79 (32.24-58.47)	1404.0 (1144.0-1664.8)
D-15	5.76 (5.23-6.31)	4.68 (4.62-4.64)	3.21 (2.39-4.22)	79.15 (64.37-94.20)	2581 (1927-3396)	63.72 (51.82-75.84)	50.47 (37.67-66.41)	1246.0 (1013.3-1483.0)
D-20	5.98 (5.44-6.52)	3.95 (3.88-3.95)	3.59 (2.70-4.67)	71.97 (58.51-85.80)	2887 (2176-3761)	57.94 (47.10-69.07)	56.46 (42.54-73.54)	1133.0 (921.1-1350.7)
D-25	6.16 (5.62-6.71)	3.43 (3.36-3.45)	3.93 (2.99-5.09)	66.49 (54.08-79.31)	3168 (2404-4095)	53.53 (43.54-63.85)	61.95 (47.00-80.08)	1046.8 (851.3-1248.6)
D-30	6.33 (5.78-6.88)	3.05 (2.97-3.07)	4.26 (3.25-5.47)	62.13 (50.57-74.11)	3428 (2615-4406)	50.02 (40.71-59.67)	67.04 (51.15-86.16)	978.2 (796.1-1166.7)
D-35	6.47 (5.93-7.02)	2.74 (2.67-2.78)	4.56 (3.50-5.83)	58.55 (47.70-69.82)	3672 (2814-4697)	47.14 (38.40-56.21)	71.81 (55.03-91.85)	921.8 (750.9-1099.1)
D-40	6.60 (6.05-7.16)	2.50 (2.43-2.53)	4.85 (3.73-6.18)	55.54 (45.29-66.19)	3903 (3002-4972)	44.72 (36.46-53.29)	76.32 (58.71-97.23)	874.4 (713.0-1042.0)
D-45	6.73 (6.17-7.28)	2.30 (2.23-2.33)	5.12 (3.95-6.50)	52.96 (43.23-63.07)	4122 (3181-5233)	42.64 (34.80-50.78)	80.61 (62.21-102.34)	833.8 (680.6-993.0)
D-50	6.84 (6.28-7.39)	2.13 (2.07-2.17)	5.38 (4.16-6.81)	50.72 (41.44-60.36)	4332 (3352-5483)	40.83 (33.36-48.59)	84.71 (65.55-107.21)	798.4 (652.4-950.2)
D-55	6.94 (6.38-7.50)	1.99 (1.93-2.02)	5.63 (4.37-7.11)	48.74 (39.87-57.96)	4533 (3516-5722)	39.24 (32.10-46.66)	88.63 (68.76-111.89)	767.3 (627.6-912.4)
D-60	7.04 (6.47-7.60)	1.86 (1.80-1.90)	5.87 (4.56-7.39)	46.98 (38.47-55.82)	4726 (3675-5952)	37.82 (30.97-44.94)	92.41 (71.86-116.38)	739.6 (605.6-878.8)
D-65	7.13 (6.56-7.69)	1.75 (1.70-1.79)	6.10 (4.75-7.67)	45.40 (37.21-53.90)	4912 (3827-6173)	36.55 (29.96-43.39)	96.06 (74.84-120.71)	714.7 (585.8-848.6)
D-70	7.21 (6.65-7.78)	1.66 (1.61-1.69)	6.33 (4.94-7.93)	43.97 (36.08-52.16)	5093 (3975-6387)	35.40 (29.04-41.99)	99.59 (77.74-124.90)	692.2 (567.9-821.2)
D-75	7.30 (6.72-7.86)	1.57 (1.52-1.61)	6.54 (5.12-8.19)	42.67 (35.04-50.58)	5268 (4119-6595)	34.35 (28.21-40.72)	103.01 (80.54-128.96)	671.8 (551.7-796.2)
D-80	7.37 (6.80-7.94)	1.50 (1.45-1.53)	6.75 (5.29-8.44)	41.48 (34.09-49.12)	5438 (4258-6796)	33.39 (27.45-39.55)	106.33 (83.27-132.89)	653.0 (536.7-773.4)
D-85	7.45 (6.87-8.01)	1.43 (1.38-1.46)	6.96 (5.46-8.68)	40.38 (33.22-47.79)	5603 (4394-6991)	32.51 (26.75-38.47)	109.56 (85.93-136.71)	635.7 (523.0-752.3)

D-90	7.52 (6.94-8.08)	1.37 (1.32-1.40)	7.16 (5.62-8.92)	39.37 (32.42-46.55)	5764 (4527-7182)	31.69 (26.10-37.48)	112.71 (88.52-140.44)	619.7 (510.3-732.8)
D-100	7.65 (7.06-8.22)	1.26 (1.22-1.29)	7.54 (5.94-9.38)	37.55 (30.97-44.33)	6074 (4782-7548)	30.23 (24.93-35.69)	118.77 (93.51-147.60)	591.1 (487.6-697.8)
D-110	7.77 (7.18-8.34)	1.17 (1.13-1.19)	7.91 (6.24-9.81)	35.95 (29.71-42.38)	6370 (5027-7898)	28.94 (23.92-34.12)	124.57 (98.30-154.44)	566.0 (467.7-667.3)
D-120	7.88 (7.29-8.46)	1.09 (1.06-1.11)	8.27 (6.54-10.23)	34.55 (28.59-40.67)	6654 (5262-8233)	27.81 (23.02-32.74)	130.12 (102.89-160.99)	543.8 (450.1-640.2)
D-150	8.18 (7.58-8.77)	0.91 (0.88-0.93)	9.25 (7.35-11.38)	31.13 (25.87-36.49)	7447 (5919-9164)	25.06 (20.83-29.38)	145.62 (115.74-179.19)	490.0 (407.3-574.4)
D-180	8.44 (7.83-9.02)	0.79 (0.76-0.80)	10.14 (8.10-12.43)	28.53 (23.81-33.32)	8167 (6519-10006)	22.97 (19.16-26.82)	159.70 (127.47-195.67)	449.1 (374.8-524.5)
D-210	8.66 (8.04-9.25)	0.69 (0.67-0.70)	10.97 (8.79-13.39)	26.46 (22.16-30.80)	8831 (7074-10781)	21.30 (17.84-24.79)	172.68 (138.32-210.81)	416.6 (348.9-484.9)
D-240	8.85 (8.24-9.45)	0.62 (0.60-0.63)	11.74 (9.43-14.28)	24.76 (20.81-28.73)	9450 (7593-11499)	19.94 (16.75-23.13)	184.78 (148.47-224.87)	389.9 (327.6-452.3)
D-270	9.03 (8.41-9.63)	0.56 (0.55-0.57)	12.46 (10.04-15.12)	23.33 (19.67-26.99)	10030 (8082-12172)	18.79 (15.84-21.73)	196.14 (158.03-238.03)	367.4 (309.7-424.9)
D-300	9.19 (8.56-9.79)	0.51 (0.50-0.52)	13.14 (10.61-15.91)	22.11 (18.69-25.49)	10579 (8545-12806)	17.80 (15.05-20.52)	206.88 (167.09-250.42)	348.0 (294.2-401.3)
D-330	9.34 (8.71-9.94)	0.47 (0.46-0.48)	13.79 (11.16-16.65)	21.04 (17.84-24.19)	11101 (8986-13406)	16.94 (14.36-19.47)	217.07 (175.72-262.16)	331.2 (280.8-380.8)
Y-1	9.50 (8.86-10.10)	0.43 (0.42-0.44)	14.51 (11.77-17.48)	19.94 (16.96-22.86)	11678 (9476-14069)	16.06 (13.66-18.41)	228.36 (185.31-275.12)	314.0 (267.0-359.9)
Y-2	10.64 (9.98-11.25)	0.23 (0.23-0.23)	20.41 (16.86-24.16)	13.41 (11.72-14.96)	16433 (13575-19447)	10.80 (9.44-12.04)	321.33 (265.45-380.29)	211.1 (184.6-235.5)
Y-3	11.33 (10.68-11.93)	0.16 (0.15-0.16)	24.68 (20.64-28.86)	10.26 (9.18-11.18)	19870 (16613-23238)	8.26 (7.39-9.00)	388.55 (324.86-454.41)	161.5 (144.5-176.0)
Y-4	11.82 (11.17-12.41)	0.12 (0.11-0.12)	28.04 (23.67-32.49)	8.28 (7.56-8.83)	22576 (19058-26155)	6.66 (6.09-7.11)	441.46 (372.67-511.45)	130.3 (119.0-138.9)
Y-5	12.19 (11.56-12.77)	0.09 (0.09-0.09)	30.79 (26.21-35.39)	6.87 (6.41-7.18)	24792 (21102-28494)	5.53 (5.16-5.78)	484.80 (412.64-557.20)	108.2 (100.8-113.0)
Y-6	12.49 (11.87-13.05)	0.07 (0.07-0.08)	33.10 (28.38-37.78)	5.81 (5.52-5.95)	26650 (22850-30416)	4.68 (4.45-4.79)	521.13 (446.82-594.77)	91.5 (87.0-93.7)
Y-7	12.73 (12.12-13.27)	0.06 (0.06-0.06)	35.07 (30.27-39.77)	4.98 (4.82-4.99)	28232 (24367-32019)	4.01 (3.88-4.02)	552.06 (476.49-626.11)	78.4 (75.9-78.6)
Y-8	12.93 (12.34-13.45)	0.05 (0.05-0.05)	36.76 (31.92-41.45)	4.30 (4.23-4.25)	29592 (25697-33370)	3.46 (3.41-3.42)	578.66 (502.50-652.55)	67.7 (66.6-66.9)
Y-9	13.10 (12.52-13.61)	0.04 (0.04-0.05)	38.22 (33.38-42.88)	3.74 (3.61-3.77)	30772 (26872-34520)	3.01 (2.91-3.03)	601.73 (525.48-675.02)	58.9 (56.8-59.3)
Y-10	13.24 (12.68-13.73)	0.04 (0.03-0.04)	39.50 (34.68-44.10)	3.27 (3.09-3.36)	31801 (27917-35502)	2.63 (2.49-2.70)	621.85 (545.91-694.24)	51.5 (48.7-52.8)
Y-11	13.36 (12.82-13.84)	0.03 (0.03-0.04)	40.62 (35.84-45.15)	2.87 (2.66-3.00)	32702 (28850-36347)	2.31 (2.15-2.42)	639.48 (564.16-710.75)	45.3 (42.0-47.3)
Y-12	13.47 (12.94-13.93)	0.03 (0.02-0.03)	41.61 (36.87-46.05)	2.53 (2.30-2.70)	33496 (29687-37076)	2.04 (1.85-2.17)	655.00 (580.51-725.00)	39.9 (36.2-42.4)
Y-13	13.56 (13.05-14.01)	0.02 (0.02-0.03)	42.48 (37.81-46.84)	2.24 (1.99-2.43)	34196 (30439-37706)	1.80 (1.61-1.95)	668.69 (595.22-737.32)	35.2 (31.4-38.2)
Y-14	13.64 (13.15-14.08)	0.02 (0.02-0.02)	43.24 (38.65-47.51)	1.98 (1.73-2.19)	34815 (31117-38253)	1.60 (1.39-1.76)	680.80 (608.48-748.01)	31.2 (27.3-34.5)
Y-15	13.72 (13.23-14.14)	0.02 (0.01-0.02)	43.93 (39.41-48.10)	1.76 (1.51-1.98)	35364 (31730-38728)	1.42 (1.21-1.60)	691.54 (620.46-757.31)	27.7 (23.7-31.2)
Y-16	13.78 (13.31-14.19)	0.02 (0.01-0.02)	44.53 (40.10-48.62)	1.56 (1.31-1.80)	35852 (32284-39141)	1.26 (1.06-1.45)	701.08 (631.31-765.39)	24.6 (20.7-28.3)
Y-17	13.83 (13.38-14.23)	0.01 (0.01-0.02)	45.07 (40.73-49.07)	1.39 (1.15-1.63)	36286 (32787-39502)	1.12 (0.92-1.31)	709.56 (641.14-772.45)	21.9 (18.0-25.7)
Y-18	13.88 (13.44-14.27)	0.01 (0.01-0.02)	45.55 (41.29-49.46)	1.24 (1.00-1.48)	36673 (33244-39817)	1.00 (0.81-1.19)	717.12 (650.07-778.61)	19.5 (15.8-23.3)
Y-19	13.93 (13.49-14.30)	0.01 (0.01-0.01)	45.98 (41.81-49.80)	1.11 (0.87-1.35)	37018 (33659-40092)	0.89 (0.70-1.08)	723.87 (658.18-783.99)	17.4 (13.8-21.2)
Y-20	13.96 (13.54-14.33)	0.01 (0.01-0.01)	46.36 (42.28-50.10)	0.99 (0.77-1.23)	37325 (34036-40333)	0.80 (0.62-0.99)	729.89 (665.57-788.69)	15.6 (12.1-19.3)

Y-21	14.00 (13.59-14.35)	0.01 (0.01-0.01)	46.70 (42.70-50.36)	0.88 (0.67-1.12)	37600 (34380-40543)	0.71 (0.54-0.90)	735.26 (672.30-792.81)	13.9 (10.6-17.6)
Y-22	14.03 (13.63-14.37)	0.01 (0.01-0.01)	47.01 (43.09-50.59)	0.79 (0.59-1.02)	37846 (34694-40728)	0.64 (0.47-0.82)	740.07 (678.43-796.42)	12.5 (9.2-16.0)
Y-23	14.05 (13.67-14.39)	0.01 (0.00-0.01)	47.28 (43.45-50.79)	0.71 (0.51-0.93)	38066 (34980-40890)	0.57 (0.41-0.75)	744.37 (684.02-799.58)	11.1 (8.1-14.6)
Y-24	14.08 (13.70-14.41)	0.01 (0.00-0.01)	47.53 (43.77-50.97)	0.63 (0.45-0.85)	38263 (35241-41032)	0.51 (0.36-0.68)	748.22 (689.13-802.36)	10.0 (7.1-13.4)
Y-25	14.10 (13.73-14.42)	0.01 (0.00-0.01)	47.75 (44.07-51.12)	0.57 (0.40-0.78)	38440 (35480-41156)	0.46 (0.32-0.62)	751.67 (693.79-804.79)	8.9 (6.2-12.2)
Y-26	14.12 (13.76-14.44)	0.00 (0.00-0.01)	47.94 (44.34-51.26)	0.51 (0.35-0.71)	38598 (35698-41265)	0.41 (0.28-0.57)	754.76 (698.05-806.93)	8.0 (5.5-11.2)
Y-27	14.14 (13.78-14.45)	0.00 (0.00-0.01)	48.12 (44.59-51.38)	0.46 (0.31-0.65)	38739 (35897-41361)	0.37 (0.25-0.52)	757.53 (701.95-808.80)	7.2 (4.8-10.2)
Y-28	14.15 (13.81-14.46)	0.00 (0.00-0.01)	48.28 (44.81-51.48)	0.41 (0.27-0.59)	38866 (36079-41445)	0.33 (0.22-0.48)	760.02 (705.51-810.45)	6.4 (4.2-9.3)
Y-29	14.17 (13.83-14.47)	0.00 (0.00-0.01)	48.42 (45.02-51.57)	0.37 (0.24-0.54)	38980 (36246-41519)	0.30 (0.19-0.44)	762.25 (708.77-811.89)	5.8 (3.7-8.5)
Y-30	14.18 (13.85-14.47)	0.00 (0.00-0.01)	48.55 (45.21-51.65)	0.33 (0.21-0.50)	39083 (36399-41584)	0.27 (0.17-0.40)	764.25 (711.76-813.16)	5.2 (3.3-7.8)
Y-35*	14.22 (13.92-14.50)	0.00 (0.00-0.00)	49.01 (45.95-51.93)	0.19 (0.11-0.32)	39457 (36989-41808)	0.15 (0.09-0.26)	771.57 (723.31-817.54)	3.0 (1.7-5.0)
Y-40*	14.25 (13.97-14.51)	0.00 (0.00-0.00)	49.28 (46.42-52.08)	0.11 (0.06-0.21)	39676 (37372-41926)	0.09 (0.05-0.17)	775.85 (730.79-819.84)	1.8 (0.9-3.3)
Y-45*	14.26 (14.00-14.52)	0.00 (0.00-0.00)	49.44 (46.73-52.15)	0.07 (0.03-0.14)	39804 (37620-41988)	0.05 (0.02-0.11)	778.36 (735.65-821.06)	1.0 (0.5-2.1)
Y-50*	14.27 (14.02-14.52)	0.00 (0.00-0.00)	49.54 (46.93-52.19)	0.04 (0.02-0.09)	39880 (37782-42020)	0.03 (0.01-0.07)	779.83 (738.81-821.69)	0.6 (0.2-1.4)
Y-55*	14.28 (14.03-14.52)	0.00 (0.00-0.00)	49.59 (47.06-52.22)	0.02 (0.01-0.06)	39924 (37887-42038)	0.02 (0.01-0.05)	780.70 (740.87-822.03)	0.4 (0.1-0.9)
Y-60*	14.28 (14.04-14.53)	0.00 (0.00-0.00)	49.62 (47.15-52.23)	0.01 (0.00-0.04)	39950 (37956-42047)	0.01 (0.00-0.03)	781.21 (742.21-822.21)	0.2 (0.1-0.6)
Y-65*	14.28 (14.05-14.53)	0.00 (0.00-0.00)	49.64 (47.20-52.23)	0.01 (0.00-0.02)	39966 (38001-42051)	0.01 (0.00-0.02)	781.51 (743.09-822.30)	0.1 (0.0-0.4)
Y-70*	14.28 (14.05-14.53)	0.00 (0.00-0.00)	49.65 (47.24-52.24)	0.00 (0.00-0.02)	39975 (38030-42054)	0.00 (0.00-0.01)	781.69 (743.66-822.35)	0.1 (0.0-0.3)
Y-75*	14.29 (14.05-14.53)	0.00 (0.00-0.00)	49.66 (47.26-52.24)	0.00 (0.00-0.01)	39980 (38049-42055)	0.00 (0.00-0.01)	781.79 (744.04-822.38)	0.0 (0.0-0.2)
Y-80*	14.29 (14.05-14.53)	0.00 (0.00-0.00)	49.66 (47.28-52.24)	0.00 (0.00-0.01)	39983 (38062-42056)	0.00 (0.00-0.01)	781.85 (744.28-822.39)	0.0 (0.0-0.2)

Table S2. Predicted mean mass and growth rates of different tissue types (blubber, muscle, visceral and bones) of southern right whales at different ages (D=days, Y=years). Estimates are based on an animal in average body condition (BC=0), and hence represents the structural growth (not including energy deposition) of whales. Ages denoted with an asterisk are extrapolations beyond the age range of the data set (assuming a longevity of ~80 years).

Age	Blubber (kg)	Blubber growth (kg/day)	Muscle (kg)	Muscle growth (kg/day)	Visceral (kg)	Visceral growth (kg/day)	Bones (kg)	Bones growth (kg/day)
D-0	500 (340-722)	39.72 (33.31-45.51)	476 (324-687)	37.83 (31.73-43.35)	172 (117-249)	13.68 (11.48-15.68)	211 (143-305)	16.77 (14.06-19.21)
D-1	540 (373-767)	37.36 (31.10-43.14)	514 (355-731)	35.58 (29.62-41.09)	186 (129-264)	12.87 (10.71-14.86)	228 (158-324)	15.77 (13.13-18.22)
D-2	577 (404-810)	35.39 (29.30-41.12)	550 (385-772)	33.71 (27.91-39.17)	199 (139-279)	12.19 (10.09-14.17)	244 (171-342)	14.94 (12.37-17.36)
D-3	613 (433-852)	33.72 (27.80-39.36)	584 (413-811)	32.12 (26.48-37.49)	211 (149-293)	11.62 (9.58-13.56)	259 (183-360)	14.24 (11.74-16.62)
D-4	646 (461-891)	32.27 (26.53-37.82)	616 (439-849)	30.74 (25.27-36.02)	223 (159-307)	11.12 (9.14-13.03)	273 (195-376)	13.63 (11.20-15.97)
D-5	679 (488-929)	31.01 (25.42-36.44)	646 (465-885)	29.53 (24.22-34.71)	234 (168-320)	10.68 (8.76-12.55)	287 (206-392)	13.09 (10.73-15.39)
D-6	710 (513-965)	29.88 (24.46-35.21)	676 (489-919)	28.46 (23.30-33.54)	244 (177-332)	10.30 (8.43-12.13)	300 (217-407)	12.62 (10.33-14.87)
D-7	740 (538-1000)	28.88 (23.60-34.10)	704 (512-953)	27.51 (22.48-32.48)	255 (185-345)	9.95 (8.13-11.75)	312 (227-422)	12.19 (9.96-14.40)
D-8	768 (561-1034)	27.98 (22.83-33.09)	732 (535-985)	26.65 (21.75-31.51)	265 (193-356)	9.64 (7.87-11.40)	324 (237-437)	11.81 (9.64-13.97)
D-9	796 (584-1068)	27.15 (22.14-32.16)	759 (556-1017)	25.86 (21.09-30.63)	274 (201-368)	9.35 (7.63-11.08)	336 (247-451)	11.46 (9.35-13.58)
D-10	824 (606-1100)	26.40 (21.52-31.31)	784 (577-1047)	25.15 (20.49-29.82)	284 (209-379)	9.10 (7.41-10.79)	348 (256-464)	11.15 (9.08-13.22)
D-15	949 (709-1249)	23.43 (19.06-27.89)	904 (675-1190)	22.32 (18.15-26.57)	327 (244-430)	8.07 (6.57-9.61)	401 (299-527)	9.89 (8.05-11.78)
D-20	1062 (800-1383)	21.31 (17.32-25.40)	1011 (762-1317)	20.29 (16.50-24.19)	366 (276-476)	7.34 (5.97-8.75)	448 (338-584)	9.00 (7.31-10.72)
D-25	1165 (884-1506)	19.69 (16.01-23.48)	1110 (842-1435)	18.75 (15.25-22.37)	401 (305-519)	6.78 (5.52-8.09)	492 (373-636)	8.31 (6.76-9.91)
D-30	1261 (962-1620)	18.40 (14.97-21.94)	1201 (916-1543)	17.52 (14.26-20.90)	434 (331-558)	6.34 (5.16-7.56)	532 (406-684)	7.77 (6.32-9.26)
D-35	1351 (1035-1727)	17.34 (14.12-20.67)	1286 (986-1645)	16.51 (13.45-19.69)	465 (357-595)	5.97 (4.87-7.12)	570 (437-729)	7.32 (5.96-8.73)
D-40	1435 (1104-1829)	16.44 (13.41-19.60)	1367 (1052-1742)	15.66 (12.77-18.67)	494 (380-630)	5.67 (4.62-6.75)	606 (466-772)	6.94 (5.66-8.27)
D-45	1516 (1170-1925)	15.68 (12.80-18.67)	1444 (1114-1833)	14.94 (12.19-17.79)	522 (403-663)	5.40 (4.41-6.43)	640 (494-813)	6.62 (5.40-7.88)
D-50	1593 (1233-2016)	15.02 (12.27-17.87)	1517 (1174-1920)	14.30 (11.69-17.02)	549 (425-695)	5.17 (4.23-6.16)	673 (520-851)	6.34 (5.18-7.54)
D-55	1667 (1293-2104)	14.43 (11.80-17.16)	1588 (1232-2004)	13.74 (11.24-16.34)	574 (446-725)	4.97 (4.07-5.91)	704 (546-888)	6.09 (4.98-7.24)
D-60	1738 (1351-2189)	13.91 (11.39-16.53)	1655 (1287-2085)	13.25 (10.85-15.74)	599 (466-754)	4.79 (3.92-5.69)	734 (571-924)	5.87 (4.81-6.98)
D-65	1807 (1408-2270)	13.44 (11.02-15.96)	1721 (1341-2162)	12.80 (10.49-15.20)	622 (485-782)	4.63 (3.80-5.50)	763 (594-958)	5.68 (4.65-6.74)
D-70	1873 (1462-2349)	13.02 (10.68-15.44)	1784 (1392-2237)	12.40 (10.17-14.71)	645 (504-809)	4.49 (3.68-5.32)	791 (617-992)	5.50 (4.51-6.52)
D-75	1937 (1515-2425)	12.63 (10.37-14.97)	1845 (1443-2310)	12.03 (9.88-14.26)	667 (522-836)	4.35 (3.57-5.16)	818 (640-1024)	5.33 (4.38-6.32)
D-80	2000 (1566-2499)	12.28 (10.09-14.54)	1905 (1492-2380)	11.70 (9.61-13.85)	689 (540-861)	4.23 (3.48-5.01)	844 (661-1055)	5.18 (4.26-6.14)
D-85	2060 (1616-2571)	11.96 (9.84-14.15)	1963 (1539-2449)	11.39 (9.37-13.48)	710 (557-886)	4.12 (3.39-4.87)	870 (682-1086)	5.05 (4.15-5.97)

D-90	2120 (1665-2641)	11.66 (9.60-13.78)	2019 (1586-2516)	11.10 (9.14-13.13)	730 (574-910)	4.02 (3.31-4.75)	895 (703-1115)	4.92 (4.05-5.82)
D-100	2234 (1759-2776)	11.12 (9.17-13.12)	2128 (1675-2644)	10.59 (8.73-12.50)	770 (606-956)	3.83 (3.16-4.52)	943 (743-1172)	4.69 (3.87-5.54)
D-110	2343 (1849-2905)	10.64 (8.80-12.55)	2231 (1761-2766)	10.14 (8.38-11.95)	807 (637-1001)	3.67 (3.03-4.32)	989 (780-1226)	4.49 (3.71-5.30)
D-120	2447 (1935-3028)	10.23 (8.46-12.04)	2331 (1843-2884)	9.74 (8.06-11.47)	843 (667-1043)	3.52 (2.92-4.15)	1033 (817-1278)	4.32 (3.57-5.08)
D-150	2739 (2177-3370)	9.22 (7.66-10.80)	2608 (2073-3210)	8.78 (7.30-10.29)	943 (750-1161)	3.17 (2.64-3.72)	1156 (919-1423)	3.89 (3.23-4.56)
D-180	3003 (2397-3680)	8.45 (7.05-9.86)	2861 (2283-3505)	8.04 (6.71-9.40)	1035 (826-1268)	2.91 (2.43-3.40)	1268 (1012-1554)	3.57 (2.98-4.16)
D-210	3248 (2601-3965)	7.83 (6.56-9.12)	3093 (2478-3776)	7.46 (6.25-8.69)	1119 (896-1366)	2.70 (2.26-3.14)	1371 (1098-1674)	3.31 (2.77-3.85)
D-240	3475 (2792-4229)	7.33 (6.16-8.51)	3310 (2660-4028)	6.98 (5.87-8.10)	1197 (962-1457)	2.53 (2.12-2.93)	1467 (1179-1785)	3.10 (2.60-3.59)
D-270	3689 (2972-4477)	6.91 (5.82-7.99)	3513 (2831-4264)	6.58 (5.55-7.61)	1271 (1024-1542)	2.38 (2.01-2.75)	1557 (1255-1890)	2.92 (2.46-3.37)
D-300	3891 (3142-4710)	6.55 (5.53-7.55)	3706 (2993-4486)	6.23 (5.27-7.19)	1340 (1083-1623)	2.25 (1.91-2.60)	1643 (1327-1988)	2.76 (2.34-3.19)
D-330	4082 (3305-4930)	6.23 (5.28-7.16)	3888 (3148-4696)	5.93 (5.03-6.82)	1406 (1139-1699)	2.15 (1.82-2.47)	1724 (1395-2082)	2.63 (2.23-3.02)
Y-1	4295 (3485-5174)	5.90 (5.02-6.77)	4091 (3319-4928)	5.62 (4.78-6.45)	1480 (1201-1783)	2.03 (1.73-2.33)	1813 (1471-2185)	2.49 (2.12-2.86)
Y-2	6043 (4992-7152)	3.97 (3.47-4.43)	5756 (4755-6812)	3.78 (3.31-4.22)	2082 (1720-2464)	1.37 (1.20-1.53)	2551 (2108-3020)	1.68 (1.47-1.87)
Y-3	7307 (6110-8546)	3.04 (2.72-3.31)	6960 (5819-8140)	2.89 (2.59-3.15)	2517 (2105-2944)	1.05 (0.94-1.14)	3085 (2579-3608)	1.28 (1.15-1.40)
Y-4	8302 (7009-9619)	2.45 (2.24-2.61)	7908 (6676-9162)	2.33 (2.13-2.49)	2860 (2415-3314)	0.84 (0.77-0.90)	3505 (2959-4061)	1.03 (0.95-1.10)
Y-5	9118 (7760-10479)	2.04 (1.90-2.13)	8684 (7392-9981)	1.94 (1.81-2.02)	3141 (2674-3610)	0.70 (0.65-0.73)	3849 (3276-4424)	0.86 (0.80-0.90)
Y-6	9801 (8403-11186)	1.72 (1.64-1.76)	9335 (8004-10654)	1.64 (1.56-1.68)	3376 (2895-3854)	0.59 (0.56-0.61)	4138 (3548-4723)	0.73 (0.69-0.74)
Y-7	10382 (8961-11775)	1.47 (1.43-1.48)	9889 (8535-11215)	1.40 (1.36-1.41)	3577 (3087-4057)	0.51 (0.49-0.51)	4383 (3783-4971)	0.62 (0.60-0.62)
Y-8	10883 (9450-12272)	1.27 (1.25-1.26)	10365 (9001-11689)	1.21 (1.19-1.20)	3749 (3256-4228)	0.44 (0.43-0.43)	4595 (3990-5181)	0.54 (0.53-0.53)
Y-9	11317 (9883-12695)	1.11 (1.07-1.11)	10779 (9413-12092)	1.06 (1.02-1.06)	3899 (3405-4374)	0.38 (0.37-0.38)	4778 (4172-5360)	0.47 (0.45-0.47)
Y-10	11695 (10267-13056)	0.97 (0.92-0.99)	11139 (9779-12436)	0.92 (0.87-0.95)	4029 (3537-4498)	0.33 (0.32-0.34)	4938 (4335-5512)	0.41 (0.39-0.42)
Y-11	12027 (10610-13367)	0.85 (0.79-0.89)	11455 (10106-12732)	0.81 (0.75-0.85)	4143 (3655-4605)	0.29 (0.27-0.31)	5078 (4479-5643)	0.36 (0.33-0.38)
Y-12	12318 (10918-13635)	0.75 (0.68-0.80)	11733 (10399-12987)	0.71 (0.65-0.76)	4244 (3761-4697)	0.26 (0.23-0.28)	5201 (4609-5757)	0.32 (0.29-0.34)
Y-13	12576 (11194-13867)	0.66 (0.59-0.72)	11978 (10662-13208)	0.63 (0.56-0.68)	4332 (3857-4777)	0.23 (0.20-0.25)	5309 (4726-5854)	0.28 (0.25-0.30)
Y-14	12804 (11444-14068)	0.59 (0.51-0.65)	12195 (10900-13399)	0.56 (0.49-0.62)	4411 (3942-4846)	0.20 (0.18-0.22)	5406 (4831-5939)	0.25 (0.22-0.27)
Y-15	13006 (11669-14242)	0.52 (0.45-0.59)	12387 (11114-13565)	0.50 (0.42-0.56)	4481 (4020-4907)	0.18 (0.15-0.20)	5491 (4927-6013)	0.22 (0.19-0.25)
Y-16	13185 (11873-14395)	0.46 (0.39-0.53)	12558 (11309-13710)	0.44 (0.37-0.51)	4542 (4090-4959)	0.16 (0.13-0.18)	5567 (5013-6077)	0.20 (0.16-0.22)
Y-17	13345 (12058-14527)	0.41 (0.34-0.48)	12710 (11485-13837)	0.39 (0.32-0.46)	4597 (4154-5005)	0.14 (0.12-0.17)	5634 (5091-6133)	0.17 (0.14-0.20)
Y-18	13487 (12226-14643)	0.37 (0.30-0.44)	12846 (11645-13947)	0.35 (0.28-0.42)	4646 (4212-5045)	0.13 (0.10-0.15)	5694 (5162-6182)	0.16 (0.13-0.19)
Y-19	13614 (12378-14744)	0.33 (0.26-0.40)	12966 (11790-14043)	0.31 (0.25-0.38)	4690 (4264-5080)	0.11 (0.09-0.14)	5748 (5226-6225)	0.14 (0.11-0.17)
Y-20	13727 (12517-14833)	0.29 (0.23-0.36)	13074 (11922-14128)	0.28 (0.22-0.35)	4729 (4312-5110)	0.10 (0.08-0.13)	5795 (5285-6262)	0.12 (0.10-0.15)

Y-21	13828 (12644-14910)	0.26 (0.20-0.33)	13171 (12043-14202)	0.25 (0.19-0.31)	4764 (4356-5137)	0.09 (0.07-0.11)	5838 (5338-6295)	0.11 (0.08-0.14)
Y-22	13918 (12759-14978)	0.23 (0.17-0.30)	13257 (12153-14266)	0.22 (0.17-0.29)	4795 (4396-5160)	0.08 (0.06-0.10)	5876 (5387-6324)	0.10 (0.07-0.13)
Y-23	13999 (12864-15038)	0.21 (0.15-0.28)	13334 (12253-14323)	0.20 (0.15-0.26)	4823 (4432-5181)	0.07 (0.05-0.09)	5910 (5431-6349)	0.09 (0.06-0.12)
Y-24	14072 (12960-15090)	0.19 (0.13-0.25)	13403 (12344-14372)	0.18 (0.13-0.24)	4848 (4465-5199)	0.06 (0.05-0.09)	5941 (5472-6371)	0.08 (0.06-0.11)
Y-25	14137 (13048-15135)	0.17 (0.12-0.23)	13465 (12428-14416)	0.16 (0.11-0.22)	4870 (4495-5214)	0.06 (0.04-0.08)	5968 (5509-6390)	0.07 (0.05-0.10)
Y-26	14195 (13128-15176)	0.15 (0.10-0.21)	13520 (12504-14454)	0.14 (0.10-0.20)	4890 (4523-5228)	0.05 (0.04-0.07)	5993 (5543-6407)	0.06 (0.04-0.09)
Y-27	14247 (13201-15211)	0.14 (0.09-0.19)	13570 (12574-14488)	0.13 (0.09-0.18)	4908 (4548-5240)	0.05 (0.03-0.07)	6015 (5574-6422)	0.06 (0.04-0.08)
Y-28	14293 (13268-15242)	0.12 (0.08-0.18)	13614 (12638-14517)	0.12 (0.08-0.17)	4924 (4571-5251)	0.04 (0.03-0.06)	6035 (5602-6435)	0.05 (0.03-0.07)
Y-29	14335 (13330-15269)	0.11 (0.07-0.16)	13654 (12696-14543)	0.10 (0.07-0.15)	4939 (4592-5260)	0.04 (0.02-0.06)	6052 (5628-6446)	0.05 (0.03-0.07)
Y-30	14373 (13386-15293)	0.10 (0.06-0.15)	13690 (12750-14566)	0.09 (0.06-0.14)	4952 (4612-5269)	0.03 (0.02-0.05)	6068 (5651-6457)	0.04 (0.03-0.06)
Y-35*	14511 (13603-15375)	0.06 (0.03-0.09)	13821 (12957-14644)	0.05 (0.03-0.09)	4999 (4686-5297)	0.02 (0.01-0.03)	6126 (5743-6491)	0.02 (0.01-0.04)
Y-40*	14591 (13744-15419)	0.03 (0.02-0.06)	13898 (13091-14686)	0.03 (0.02-0.06)	5027 (4735-5312)	0.01 (0.01-0.02)	6160 (5803-6510)	0.01 (0.01-0.03)
Y-45*	14638 (13835-15441)	0.02 (0.01-0.04)	13943 (13177-14707)	0.02 (0.01-0.04)	5043 (4766-5320)	0.01 (0.00-0.01)	6180 (5841-6519)	0.01 (0.00-0.02)
Y-50*	14666 (13895-15453)	0.01 (0.00-0.03)	13969 (13234-14719)	0.01 (0.00-0.02)	5053 (4787-5324)	0.00 (0.00-0.01)	6192 (5866-6524)	0.00 (0.00-0.01)
Y-55*	14682 (13933-15460)	0.01 (0.00-0.02)	13985 (13271-14725)	0.01 (0.00-0.02)	5058 (4800-5326)	0.00 (0.00-0.01)	6199 (5883-6527)	0.00 (0.00-0.01)
Y-60*	14692 (13959-15463)	0.00 (0.00-0.01)	13994 (13295-14728)	0.00 (0.00-0.01)	5062 (4809-5327)	0.00 (0.00-0.00)	6203 (5893-6528)	0.00 (0.00-0.00)
Y-65*	14698 (13975-15465)	0.00 (0.00-0.01)	13999 (13311-14730)	0.00 (0.00-0.01)	5063 (4815-5328)	0.00 (0.00-0.00)	6205 (5900-6529)	0.00 (0.00-0.00)
Y-70*	14701 (13986-15466)	0.00 (0.00-0.00)	14002 (13321-14731)	0.00 (0.00-0.00)	5065 (4818-5328)	0.00 (0.00-0.00)	6207 (5905-6530)	0.00 (0.00-0.00)
Y-75*	14703 (13993-15466)	0.00 (0.00-0.00)	14004 (13328-14731)	0.00 (0.00-0.00)	5065 (4821-5328)	0.00 (0.00-0.00)	6207 (5908-6530)	0.00 (0.00-0.00)
Y-80*	14704 (13998-15466)	0.00 (0.00-0.00)	14005 (13332-14731)	0.00 (0.00-0.00)	5066 (4822-5328)	0.00 (0.00-0.00)	6208 (5910-6530)	0.00 (0.00-0.00)

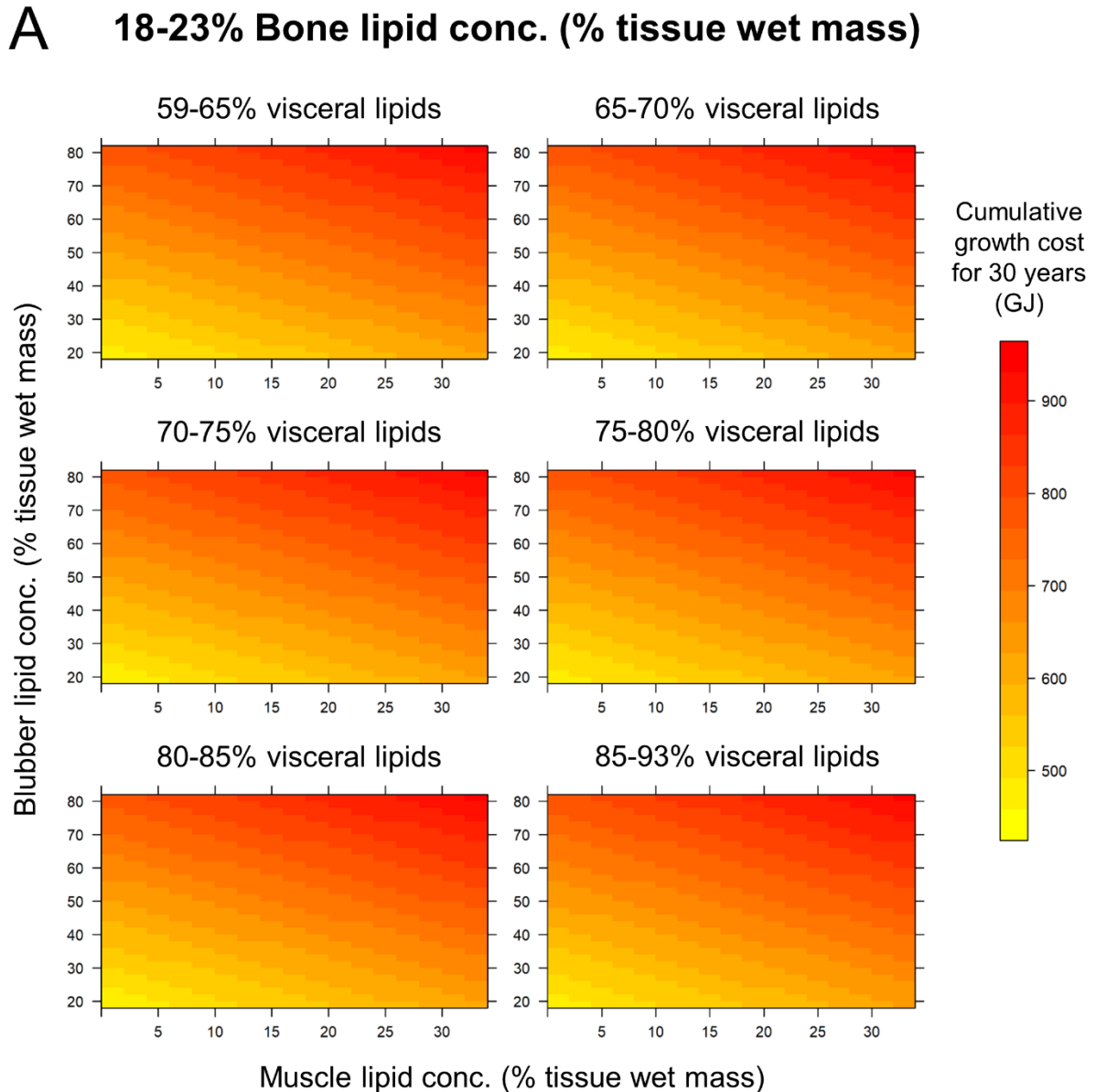
Table S3. Predicted mean energy content and daily cost of growth of different tissue types (blubber, muscle, visceral and bones) of southern right whales at different ages (D=days, Y=years). Estimates are based on an animal in average body condition (BC=0), and hence represents the structural growth (not including energy deposition) of whales. Ages denoted with an asterisk are extrapolations beyond the age range of the data set (assuming a longevity of ~80 years).

Age	Blubber energy content (GJ)	Blubber cost of growth (MJ/day)	Muscle energy content (GJ)	Muscle cost of growth (MJ/day)	Visceral energy content (GJ)	Visceral cost of growth (MJ/day)	Bones energy content (GJ)	Bones cost of growth (MJ/day)
D-0	13.59 (9.23-19.60)	1078.8 (904.9-1236.2)	4.64 (3.15-6.69)	368.2 (308.8-421.8)	5.32 (3.61-7.67)	422.1 (354.0-483.6)	3.06 (2.08-4.41)	242.8 (203.7-278.3)
D-1	14.67 (10.13-20.84)	1014.8 (844.7-1171.9)	5.00 (3.46-7.11)	346.3 (288.3-399.9)	5.74 (3.96-8.15)	397.0 (330.5-458.5)	3.30 (2.28-4.69)	228.4 (190.1-263.8)
D-2	15.68 (10.98-22.01)	961.4 (795.9-1116.9)	5.35 (3.75-7.51)	328.1 (271.6-381.2)	6.13 (4.29-8.61)	376.1 (311.4-437.0)	3.53 (2.47-4.95)	216.4 (179.2-251.4)
D-3	16.64 (11.77-23.13)	915.9 (755.2-1069.2)	5.68 (4.02-7.89)	312.6 (257.7-364.9)	6.51 (4.61-9.05)	358.3 (295.4-418.3)	3.75 (2.65-5.21)	206.2 (170.0-240.7)
D-4	17.56 (12.53-24.20)	876.6 (720.6-1027.2)	5.99 (4.28-8.26)	299.2 (245.9-350.5)	6.87 (4.90-9.47)	343.0 (281.9-401.9)	3.95 (2.82-5.45)	197.3 (162.2-231.2)
D-5	18.43 (13.25-25.23)	842.2 (690.6-989.9)	6.29 (4.52-8.61)	287.4 (235.7-337.8)	7.21 (5.18-9.87)	329.5 (270.2-387.3)	4.15 (2.98-5.68)	189.6 (155.5-222.8)
D-6	19.28 (13.94-26.22)	811.7 (664.3-956.4)	6.58 (4.76-8.95)	277.0 (226.7-326.4)	7.54 (5.45-10.26)	317.6 (259.9-374.2)	4.34 (3.14-5.90)	182.7 (149.5-215.3)
D-7	20.09 (14.60-27.17)	784.5 (641.1-926.2)	6.86 (4.98-9.27)	267.7 (218.8-316.1)	7.86 (5.71-10.63)	306.9 (250.8-362.3)	4.52 (3.29-6.12)	176.6 (144.3-208.5)
D-8	20.87 (15.25-28.10)	759.9 (620.2-898.7)	7.12 (5.20-9.59)	259.3 (211.7-306.7)	8.17 (5.96-10.99)	297.3 (242.6-351.6)	4.70 (3.43-6.32)	171.0 (139.6-202.3)
D-9	21.63 (15.87-29.00)	737.6 (601.5-873.6)	7.38 (5.41-9.90)	251.7 (205.2-298.1)	8.46 (6.21-11.34)	288.6 (235.3-341.7)	4.87 (3.57-6.53)	166.0 (135.4-196.6)
D-10	22.37 (16.47-29.87)	717.2 (584.4-850.4)	7.63 (5.62-10.19)	244.7 (199.4-290.2)	8.75 (6.44-11.69)	280.6 (228.6-332.7)	5.04 (3.71-6.72)	161.4 (131.5-191.4)
D-15	25.78 (19.25-33.92)	636.5 (517.6-757.6)	8.80 (6.57-11.58)	217.2 (176.6-258.5)	10.09 (7.53-13.27)	249.0 (202.5-296.4)	5.80 (4.33-7.64)	143.3 (116.5-170.5)
D-20	28.84 (21.73-37.57)	578.8 (470.5-690.0)	9.84 (7.42-12.82)	197.5 (160.6-235.5)	11.28 (8.50-14.7)	226.4 (184.1-269.9)	6.49 (4.89-8.46)	130.3 (105.9-155.3)
D-25	31.64 (24.01-40.91)	534.7 (434.9-637.8)	10.80 (8.19-13.96)	182.5 (148.4-217.7)	12.38 (9.39-16.00)	209.2 (170.1-249.5)	7.12 (5.40-9.21)	120.4 (97.9-143.6)
D-30	34.24 (26.13-44.01)	499.7 (406.7-596.0)	11.69 (8.92-15.02)	170.5 (138.8-203.4)	13.40 (10.22-17.22)	195.5 (159.1-233.2)	7.71 (5.88-9.91)	112.5 (91.5-134.2)
D-35	36.68 (28.11-46.92)	470.9 (383.6-561.5)	12.52 (9.59-16.01)	160.7 (130.9-191.6)	14.35 (11.00-18.36)	184.2 (150.1-219.7)	8.26 (6.33-10.56)	106.0 (86.3-126.4)
D-40	38.99 (29.99-49.67)	446.7 (364.2-532.3)	13.3 (10.23-16.95)	152.4 (124.3-181.7)	15.25 (11.73-19.43)	174.7 (142.5-208.3)	8.78 (6.75-11.18)	100.5 (82.0-119.8)
D-45	41.18 (31.78-52.28)	425.9 (347.7-507.3)	14.05 (10.84-17.84)	145.3 (118.6-173.1)	16.11 (12.43-20.45)	166.6 (136.0-198.4)	9.27 (7.15-11.77)	95.9 (78.3-114.2)
D-50	43.27 (33.49-54.77)	407.9 (333.3-485.4)	14.77 (11.43-18.69)	139.2 (113.7-165.6)	16.93 (13.10-21.43)	159.6 (130.4-189.9)	9.74 (7.54-12.33)	91.8 (75.0-109.3)
D-55	45.28 (35.13-57.16)	392.0 (320.6-466.1)	15.45 (11.99-19.50)	133.8 (109.4-159.1)	17.71 (13.74-22.36)	153.3 (125.4-182.4)	10.19 (7.91-12.87)	88.2 (72.2-104.9)
D-60	47.21 (36.71-59.45)	377.8 (309.4-448.9)	16.11 (12.53-20.29)	128.9 (105.6-153.2)	18.47 (14.36-23.26)	147.8 (121.0-175.6)	10.63 (8.26-13.38)	85.0 (69.6-101.1)
D-65	49.07 (38.23-61.66)	365.1 (299.3-433.5)	16.75 (13.05-21.04)	124.6 (102.1-147.9)	19.20 (14.96-24.12)	142.8 (117.1-169.6)	11.05 (8.61-13.88)	82.2 (67.4-97.6)
D-70	50.87 (39.71-63.80)	353.6 (290.1-419.5)	17.36 (13.55-21.77)	120.7 (99.0-143.2)	19.90 (15.54-24.96)	138.3 (113.5-164.1)	11.45 (8.94-14.36)	79.6 (65.3-94.4)
D-75	52.62 (41.14-65.88)	343.2 (281.8-406.7)	17.96 (14.04-22.48)	117.1 (96.2-138.8)	20.59 (16.10-25.77)	134.2 (110.2-159.1)	11.84 (9.26-14.83)	77.2 (63.4-91.6)
D-80	54.32 (42.54-67.89)	333.6 (274.2-395.1)	18.54 (14.52-23.17)	113.8 (93.6-134.8)	21.25 (16.64-26.56)	130.5 (107.3-154.6)	12.23 (9.58-15.28)	75.1 (61.7-88.9)
D-85	55.97 (43.89-69.84)	324.7 (267.2-384.3)	19.10 (14.98-23.83)	110.8 (91.2-131.1)	21.90 (17.17-27.32)	127.0 (104.5-150.3)	12.60 (9.88-15.72)	73.1 (60.1-86.5)

D-90	57.57 (45.22-71.74)	316.6 (260.7-374.4)	19.65 (15.43-24.48)	108.0 (89.0-127.7)	22.52 (17.69-28.07)	123.9 (102.0-146.5)	12.96 (10.18-16.15)	71.3 (58.7-84.3)
D-100	60.67 (47.77-75.40)	301.9 (249.1-356.5)	20.70 (16.30-25.73)	103.0 (85.0-121.7)	23.74 (18.69-29.50)	118.1 (97.4-139.5)	13.66 (10.75-16.97)	68.0 (56.1-80.2)
D-110	63.63 (50.21-78.89)	289.1 (238.9-340.9)	21.71 (17.14-26.92)	98.7 (81.5-116.3)	24.89 (19.64-30.86)	113.1 (93.5-133.3)	14.32 (11.30-17.76)	65.1 (53.8-76.7)
D-120	66.47 (52.56-82.24)	277.8 (229.9-327.0)	22.68 (17.94-28.06)	94.8 (78.5-111.6)	26.01 (20.56-32.17)	108.7 (89.9-127.9)	14.96 (11.83-18.51)	62.5 (51.8-73.6)
D-150	74.39 (59.13-91.54)	250.3 (208.1-293.5)	25.38 (20.18-31.24)	85.4 (71.0-100.1)	29.10 (23.13-35.81)	97.9 (81.4-114.8)	16.74 (13.31-20.60)	56.3 (46.8-66.1)
D-180	81.58 (65.12-99.96)	229.4 (191.4-267.9)	27.84 (22.22-34.11)	78.3 (65.3-91.4)	31.92 (25.47-39.10)	89.8 (74.9-104.8)	18.36 (14.66-22.50)	51.6 (43.1-60.3)
D-210	88.21 (70.66-107.69)	212.8 (178.2-247.7)	30.10 (24.11-36.75)	72.6 (60.8-84.5)	34.51 (27.64-42.13)	83.3 (69.7-96.9)	19.86 (15.91-24.24)	47.9 (40.1-55.8)
D-240	94.39 (75.85-114.87)	199.2 (167.3-231.0)	32.21 (25.88-39.20)	68.0 (57.1-78.8)	36.93 (29.67-44.94)	77.9 (65.5-90.4)	21.25 (17.07-25.86)	44.8 (37.7-52.0)
D-270	100.20 (80.73-121.59)	187.7 (158.2-217.0)	34.19 (27.55-41.49)	64.0 (54.0-74.1)	39.20 (31.58-47.57)	73.4 (61.9-84.9)	22.55 (18.17-27.37)	42.2 (35.6-48.9)
D-300	105.68 (85.36-127.93)	177.8 (150.3-205.0)	36.06 (29.13-43.65)	60.7 (51.3-70.0)	41.34 (33.39-50.05)	69.6 (58.8-80.2)	23.79 (19.21-28.80)	40.0 (33.8-46.1)
D-330	110.89 (89.76-133.92)	169.2 (143.4-194.5)	37.84 (30.63-45.70)	57.7 (48.9-66.4)	43.38 (35.12-52.39)	66.2 (56.1-76.1)	24.96 (20.21-30.15)	38.1 (32.3-43.8)
Y-1	116.65 (94.66-140.54)	160.4 (136.4-183.9)	39.81 (32.30-47.96)	54.7 (46.6-62.7)	45.64 (37.03-54.98)	62.7 (53.4-71.9)	26.26 (21.31-31.64)	36.1 (30.7-41.4)
Y-2	164.15 (135.6-194.27)	107.9 (94.3-120.3)	56.02 (46.27-66.29)	36.8 (32.2-41.0)	64.22 (53.05-76.00)	42.2 (36.9-47.1)	36.95 (30.52-43.73)	24.3 (21.2-27.1)
Y-3	198.49 (165.95-232.13)	82.5 (73.8-89.9)	67.73 (56.63-79.21)	28.2 (25.2-30.7)	77.65 (64.92-90.81)	32.3 (28.9-35.2)	44.68 (37.36-52.25)	18.6 (16.6-20.2)
Y-4	225.52 (190.37-261.27)	66.6 (60.8-71.0)	76.96 (64.97-89.16)	22.7 (20.7-24.2)	88.23 (74.48-102.21)	26.0 (23.8-27.8)	50.76 (42.85-58.81)	15.0 (13.7-16.0)
Y-5	247.66 (210.79-284.64)	55.3 (51.5-57.7)	84.51 (71.93-97.13)	18.9 (17.6-19.7)	96.89 (82.47-111.35)	21.6 (20.2-22.6)	55.75 (47.45-64.07)	12.4 (11.6-13.0)
Y-6	266.22 (228.25-303.83)	46.8 (44.4-47.9)	90.85 (77.89-103.68)	16.0 (15.2-16.3)	104.15 (89.30-118.86)	18.3 (17.4-18.7)	59.92 (51.38-68.39)	10.5 (10.0-10.8)
Y-7	282.01 (243.41-319.84)	40.0 (38.8-40.2)	96.24 (83.06-109.15)	13.7 (13.2-13.7)	110.33 (95.23-125.13)	15.7 (15.2-15.7)	63.48 (54.79-72.00)	9.0 (8.7-9.0)
Y-8	295.60 (256.69-333.35)	34.6 (34.0-34.2)	100.87 (87.60-113.75)	11.8 (11.6-11.7)	115.64 (100.42-130.41)	13.5 (13.3-13.4)	66.54 (57.78-75.04)	7.8 (7.7-7.7)
Y-9	307.39 (268.44-344.83)	30.1 (29.0-30.3)	104.90 (91.60-117.67)	10.3 (9.9-10.3)	120.25 (105.02-134.90)	11.8 (11.4-11.8)	69.19 (60.42-77.62)	6.8 (6.5-6.8)
Y-10	317.66 (278.87-354.64)	26.3 (24.9-27.0)	108.40 (95.17-121.02)	9.0 (8.5-9.2)	124.28 (109.10-138.74)	10.3 (9.7-10.6)	71.51 (62.77-79.83)	5.9 (5.6-6.1)
Y-11	326.67 (288.19-363.08)	23.1 (21.4-24.1)	111.48 (98.35-123.90)	7.9 (7.3-8.2)	127.80 (112.75-142.04)	9.0 (8.4-9.4)	73.53 (64.87-81.73)	5.2 (4.8-5.4)
Y-12	334.60 (296.55-370.36)	20.4 (18.5-21.7)	114.18 (101.2-126.38)	7.0 (6.3-7.4)	130.90 (116.01-144.89)	8.0 (7.2-8.5)	75.32 (66.75-83.37)	4.6 (4.2-4.9)
Y-13	341.59 (304.06-376.65)	18.0 (16.0-19.5)	116.57 (103.76-128.53)	6.1 (5.5-6.7)	133.64 (118.95-147.35)	7.0 (6.3-7.6)	76.89 (68.44-84.78)	4.1 (3.6-4.4)
Y-14	347.78 (310.84-382.11)	15.9 (13.9-17.6)	118.68 (106.07-130.40)	5.4 (4.8-6.0)	136.06 (121.60-149.49)	6.2 (5.4-6.9)	78.28 (69.97-86.01)	3.6 (3.1-4.0)
Y-15	353.27 (316.96-386.86)	14.2 (12.1-15.9)	120.55 (108.16-132.02)	4.8 (4.1-5.4)	138.20 (124.00-151.35)	5.5 (4.7-6.2)	79.52 (71.35-87.08)	3.2 (2.7-3.6)
Y-16	358.14 (322.50-390.99)	12.6 (10.6-14.4)	122.21 (110.05-133.43)	4.3 (3.6-4.9)	140.11 (126.17-152.96)	4.9 (4.1-5.6)	80.62 (72.59-88.01)	2.8 (2.4-3.3)
Y-17	362.47 (327.52-394.60)	11.2 (9.2-13.1)	123.69 (111.77-134.66)	3.8 (3.1-4.5)	141.81 (128.13-154.37)	4.4 (3.6-5.1)	81.59 (73.72-88.82)	2.5 (2.1-2.9)
Y-18	366.34 (332.08-397.74)	10.0 (8.0-11.9)	125.01 (113.32-135.73)	3.4 (2.7-4.1)	143.32 (129.92-155.60)	3.9 (3.1-4.7)	82.46 (74.75-89.53)	2.2 (1.8-2.7)
Y-19	369.78 (336.23-400.49)	8.9 (7.0-10.8)	126.19 (114.74-136.67)	3.0 (2.4-3.7)	144.66 (131.54-156.68)	3.5 (2.8-4.2)	83.24 (75.68-90.15)	2.0 (1.6-2.4)
Y-20	372.85 (340.00-402.89)	8.0 (6.2-9.9)	127.24 (116.02-137.49)	2.7 (2.1-3.4)	145.87 (133.01-157.62)	3.1 (2.4-3.9)	83.93 (76.53-90.69)	1.8 (1.4-2.2)

Y-21	375.60 (343.44-405.00)	7.1 (5.4-9.0)	128.17 (117.20-138.21)	2.4 (1.8-3.1)	146.94 (134.36-158.44)	2.8 (2.1-3.5)	84.55 (77.31-91.16)	1.6 (1.2-2.0)
Y-22	378.06 (346.57-406.84)	6.4 (4.7-8.2)	129.01 (118.27-138.83)	2.2 (1.6-2.8)	147.90 (135.58-159.16)	2.5 (1.8-3.2)	85.10 (78.01-91.58)	1.4 (1.1-1.8)
Y-23	380.25 (349.42-408.46)	5.7 (4.1-7.5)	129.76 (119.24-139.39)	1.9 (1.4-2.6)	148.76 (136.70-159.80)	2.2 (1.6-2.9)	85.59 (78.65-91.94)	1.3 (0.9-1.7)
Y-24	382.22 (352.03-409.88)	5.1 (3.6-6.8)	130.43 (120.13-139.87)	1.7 (1.2-2.3)	149.53 (137.72-160.35)	2.0 (1.4-2.7)	86.04 (79.24-92.26)	1.1 (0.8-1.5)
Y-25	383.98 (354.42-411.12)	4.6 (3.2-6.2)	131.03 (120.94-140.29)	1.6 (1.1-2.1)	150.22 (138.65-160.84)	1.8 (1.2-2.4)	86.43 (79.78-92.54)	1.0 (0.7-1.4)
Y-26	385.56 (356.59-412.21)	4.1 (2.8-5.7)	131.57 (121.69-140.67)	1.4 (1.0-1.9)	150.84 (139.50-161.26)	1.6 (1.1-2.2)	86.79 (80.27-92.79)	0.9 (0.6-1.3)
Y-27	386.98 (358.58-413.17)	3.7 (2.5-5.2)	132.06 (122.37-140.99)	1.3 (0.8-1.8)	151.39 (140.28-161.64)	1.4 (1.0-2.0)	87.11 (80.72-93.00)	0.8 (0.6-1.2)
Y-28	388.25 (360.40-414.01)	3.3 (2.2-4.8)	132.49 (122.99-141.28)	1.1 (0.7-1.6)	151.89 (141.00-161.97)	1.3 (0.8-1.9)	87.39 (81.13-93.19)	0.7 (0.5-1.1)
Y-29	389.39 (362.07-414.75)	3.0 (1.9-4.4)	132.88 (123.56-141.53)	1.0 (0.6-1.5)	152.33 (141.65-162.26)	1.2 (0.7-1.7)	87.65 (81.50-93.36)	0.7 (0.4-1.0)
Y-30	390.41 (363.59-415.39)	2.7 (1.7-4.0)	133.23 (124.08-141.75)	0.9 (0.6-1.4)	152.73 (142.24-162.51)	1.0 (0.7-1.6)	87.88 (81.84-93.50)	0.6 (0.4-0.9)
Y-35*	394.15 (369.50-417.63)	1.5 (0.9-2.6)	134.50 (126.09-142.52)	0.5 (0.3-0.9)	154.20 (144.55-163.38)	0.6 (0.3-1.0)	88.72 (83.17-94.01)	0.3 (0.2-0.6)
Y-40*	396.33 (373.32-418.81)	0.9 (0.5-1.7)	135.25 (127.39-142.92)	0.3 (0.2-0.6)	155.05 (146.05-163.84)	0.4 (0.2-0.7)	89.21 (84.03-94.27)	0.2 (0.1-0.4)
Y-45*	397.62 (375.80-419.43)	0.5 (0.2-1.1)	135.69 (128.24-143.13)	0.2 (0.1-0.4)	155.55 (147.02-164.09)	0.2 (0.1-0.4)	89.50 (84.59-94.41)	0.1 (0.1-0.2)
Y-50*	398.37 (377.41-419.75)	0.3 (0.1-0.7)	135.94 (128.79-143.24)	0.1 (0.0-0.2)	155.85 (147.65-164.21)	0.1 (0.0-0.3)	89.67 (84.95-94.49)	0.1 (0.0-0.2)
Y-55*	398.81 (378.46-419.93)	0.2 (0.1-0.5)	136.09 (129.15-143.30)	0.1 (0.0-0.2)	156.02 (148.06-164.28)	0.1 (0.0-0.2)	89.77 (85.19-94.52)	0.0 (0.0-0.1)
Y-60*	399.07 (379.15-420.02)	0.1 (0.0-0.3)	136.18 (129.38-143.33)	0.0 (0.0-0.1)	156.12 (148.33-164.32)	0.0 (0.0-0.1)	89.83 (85.35-94.54)	0.0 (0.0-0.1)
Y-65*	399.23 (379.60-420.06)	0.1 (0.0-0.2)	136.24 (129.54-143.35)	0.0 (0.0-0.1)	156.18 (148.51-164.34)	0.0 (0.0-0.1)	89.87 (85.45-94.56)	0.0 (0.0-0.0)
Y-70*	399.32 (379.89-420.09)	0.0 (0.0-0.1)	136.27 (129.64-143.36)	0.0 (0.0-0.0)	156.22 (148.62-164.35)	0.0 (0.0-0.1)	89.89 (85.51-94.56)	0.0 (0.0-0.0)
Y-75*	399.37 (380.08-420.10)	0.0 (0.0-0.1)	136.28 (129.70-143.36)	0.0 (0.0-0.0)	156.24 (148.69-164.35)	0.0 (0.0-0.0)	89.90 (85.56-94.56)	0.0 (0.0-0.0)
Y-80*	399.40 (380.21-420.11)	0.0 (0.0-0.1)	136.30 (129.75-143.36)	0.0 (0.0-0.0)	156.25 (148.74-164.35)	0.0 (0.0-0.0)	89.90 (85.58-94.57)	0.0 (0.0-0.0)

Figure S1. Contour plots showing the cumulative energy cost of growth from birth to 30 years of age for a southern right whale as a function of the lipid concentration (% tissue wet weight) in the blubber (y-axes), muscle (x-axes), visceral (sub-figures) and bone tissues (figure A versus B). The corresponding protein concentration for each tissue was predicted from the lipid concentration, using the linear relationships for the specific tissues (see Fig. S2), except for bones, where the protein concentration was kept constant at 25% wet weight.



B 23-26% Bone lipid conc. (% tissue wet mass)

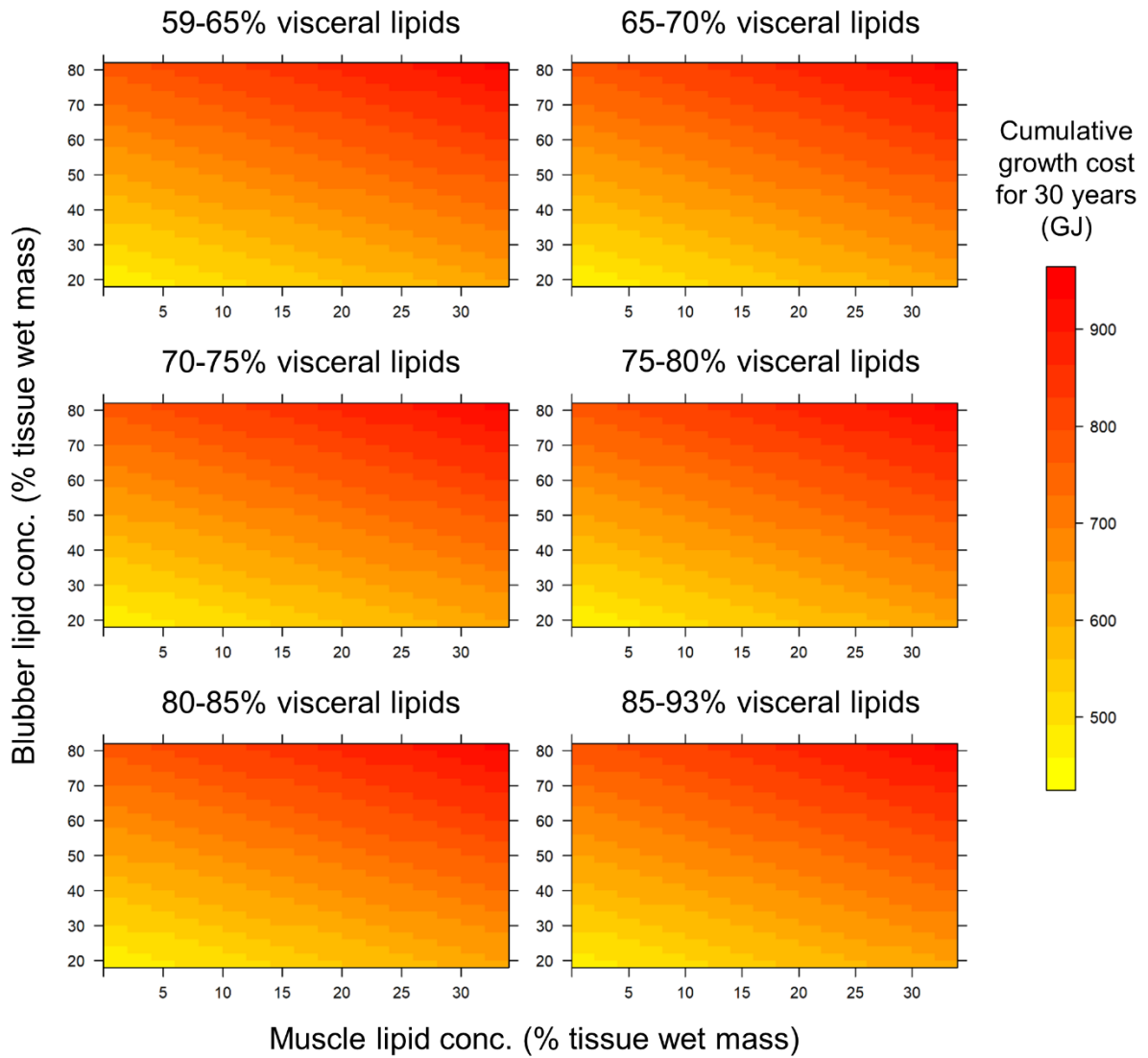


Figure S2. Relationship between protein (P) and lipid (L) concentrations (% wet mass) in (A) blubber (LM: $P=23.0-0.212\times L$; $F_{1,42}=93.26$, $p<0.001$, $R^2=0.690$), (B) muscle (LM: $P=24.4-0.229\times L$; $F_{1,41}=33.02$, $p<0.001$, $R^2=0.446$) and (C) visceral tissues (LM: $P=14.0-0.139\times L$; $F_{1,11}=14.04$, $p=0.003$, $R^2=0.561$) of fin, sei and minke whales (see key). The solid lines represent the fitted lines of linear models fitted between the two variables for each tissue type. Data from Lockyer et al. (1985), Lockyer (1987), Vikingsson (1990), and Vikingsson et al. (2013).

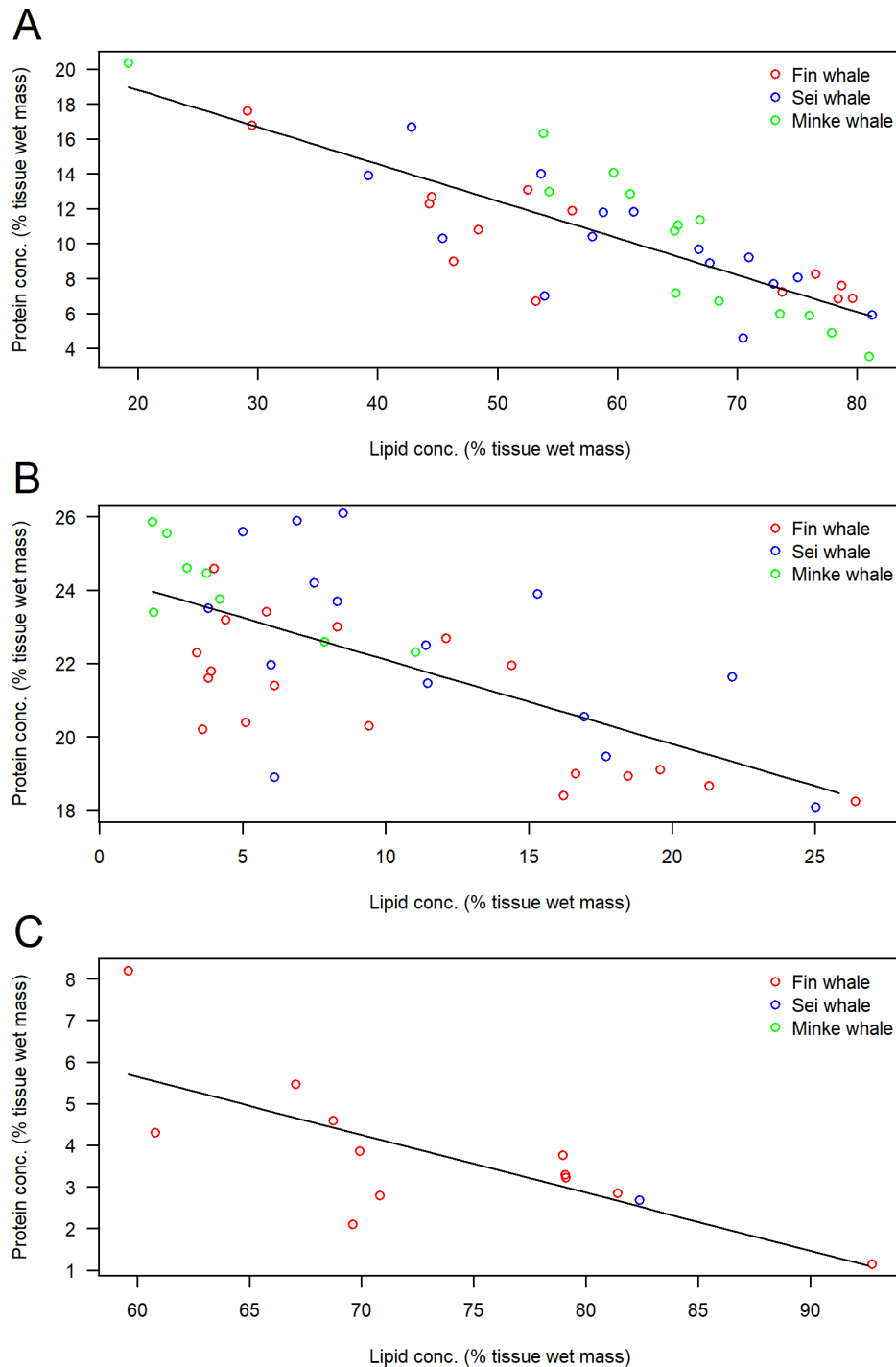


Figure S3. Frequency histograms of body lengths of southern right whale (A) calves, (B) yearlings, (C) juveniles, (D) non-pregnant/non-lactating adults, (E) late-pregnant females and (F) lactating females. For the sample size of each reproductive class, see Table 1 in the main manuscript.

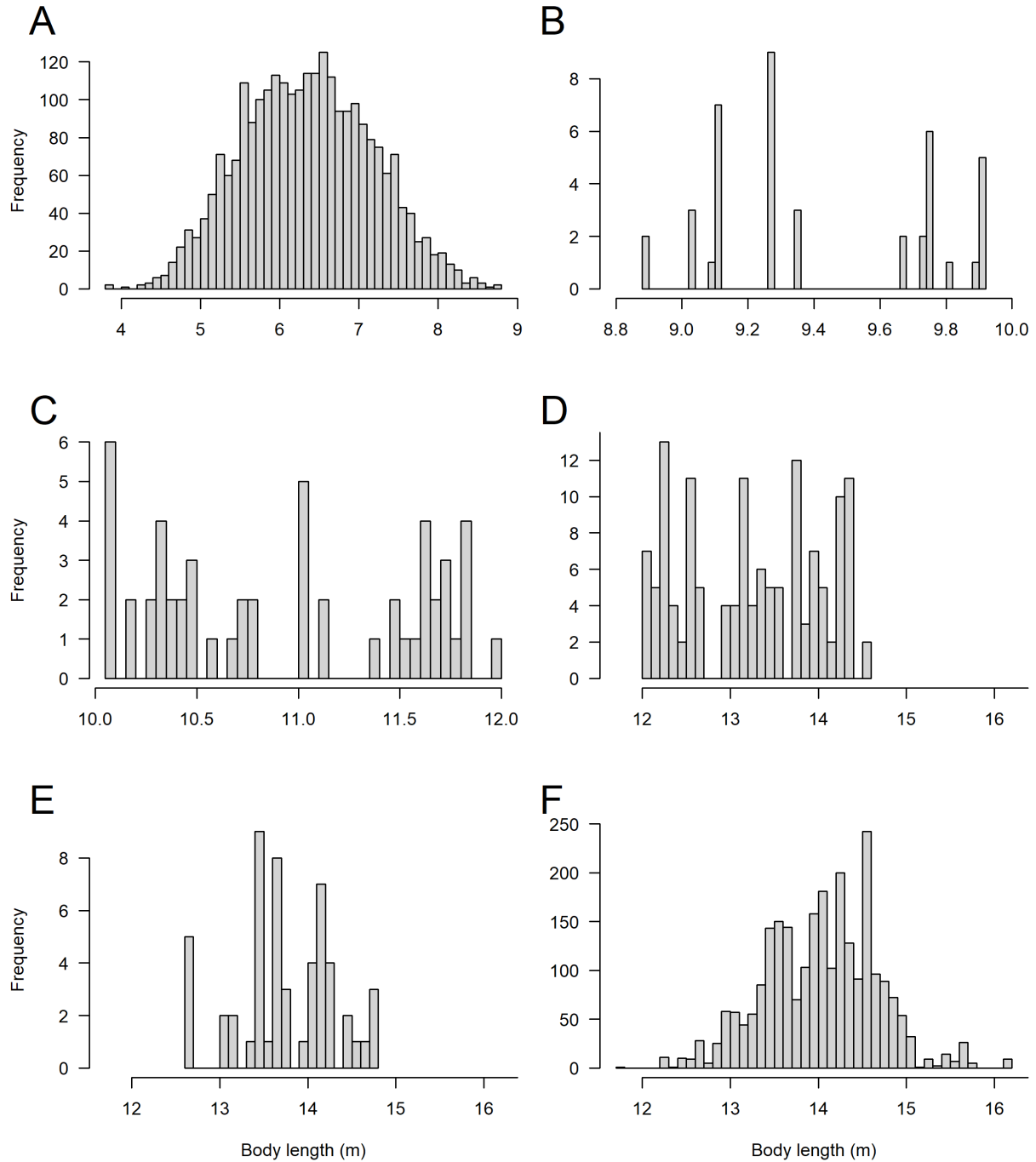


Figure S4. Frequency histograms of calf growth rates in (A) body volume and (B) body length. n=161 calves.

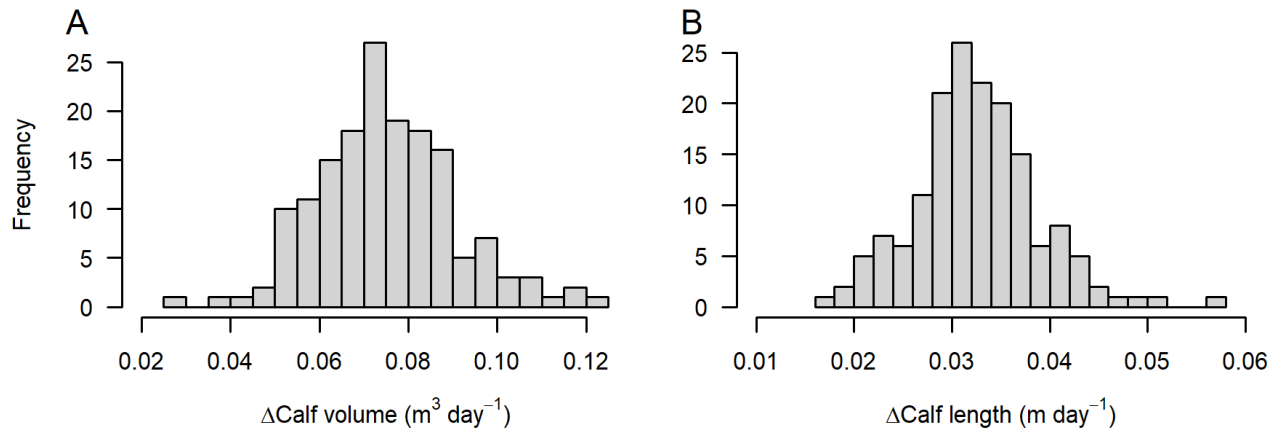


Figure S5. von Bertalanffy growth curves for southern right whales, showing the predicted mean body length of animals across (A) the full age range of the raw data, (B) the full life-expectancy of the species, (C) the age range of immature animals (calves, yearlings and juveniles), and (D) the first four months (120 days) after birth. The colours of the solid lines represent the different transformations (see key) used for the age variable in the growth models. The dotted red horizontal lines show the minimum (3.9m) and maximum (16.2m) body lengths measured in this study. The dashed black horizontal line shows the mean length (14m) of mature whales. The dotted black horizontal line shows the minimum length at sexual maturity (12m) and the two dotted black vertical lines show the age at sexual maturity (5 years) and minimum age at first parturition (6 years) for the South Australian population. n=2,035 measurements from 205 individuals.

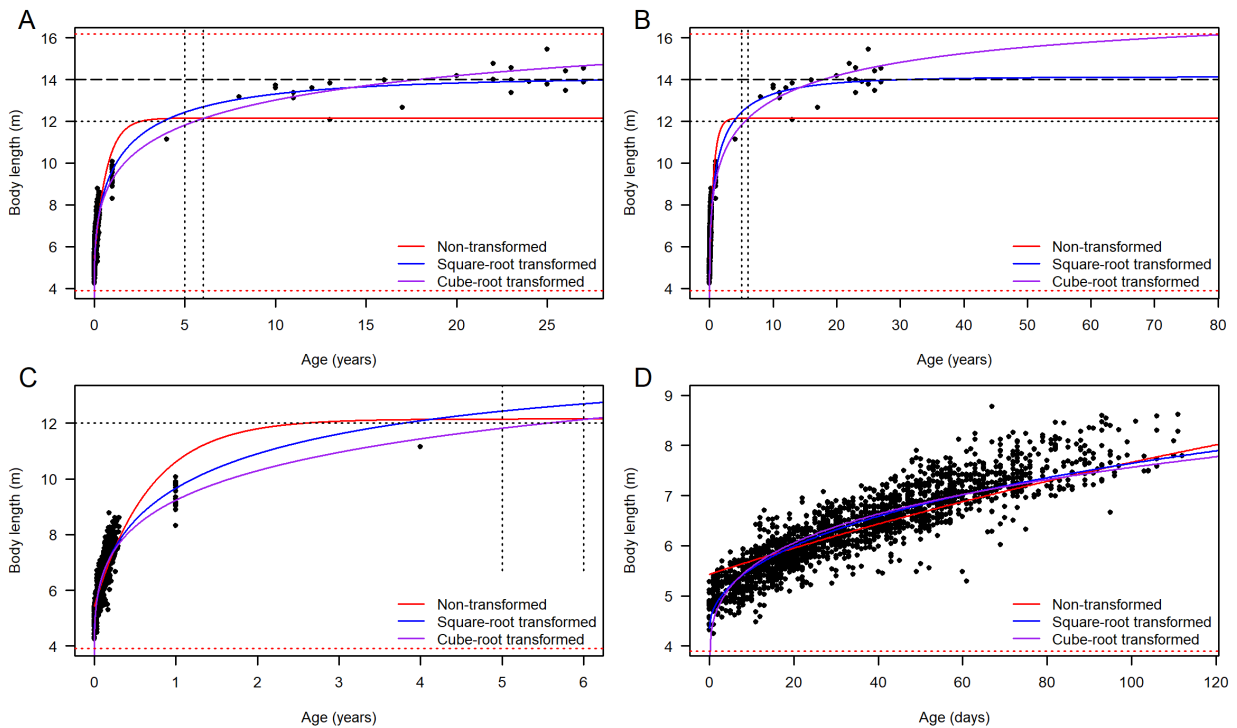


Figure S6. Richards growth curves for southern right whales, showing the predicted mean body length of animals across (A) the full age range of the raw data, (B) the full life-expectancy of the species, (C) the age range of immature animals (calves, yearlings and juveniles), and (D) the first four months (120 days) after birth. The colours of the solid lines represent the different transformations (see key) used for the age variable in the growth models. The dotted red horizontal lines show the minimum (3.9m) and maximum (16.2m) body lengths measured in this study. The dashed black horizontal line shows the mean length (14m) of mature whales. The dotted black horizontal line shows the minimum length at sexual maturity (12m) and the two dotted black vertical lines show the age at sexual maturity (5 years) and minimum age at first parturition (6 years) for the South Australian population. n=2,035 measurements from 205 individuals.

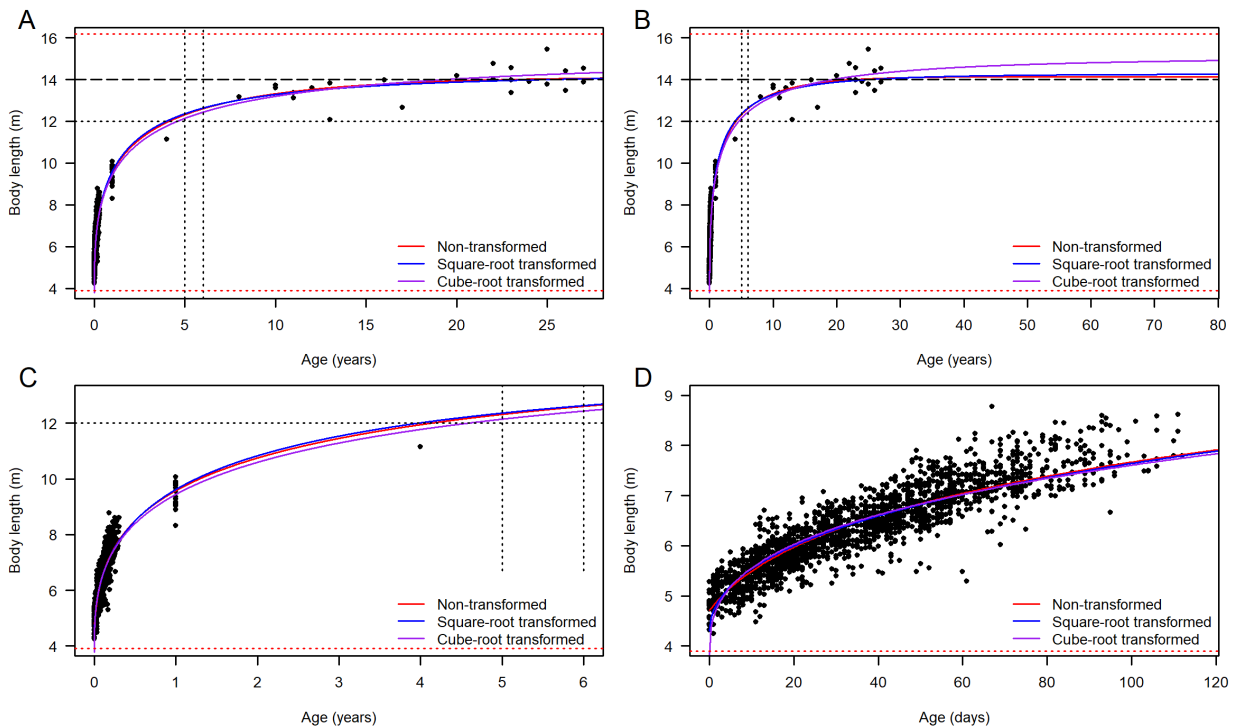


Figure S7. Logistic growth curves for southern right whales, showing the predicted mean body length of animals across (A) the full age range of the raw data, (B) the full life-expectancy of the species, (C) the age range of immature animals (calves, yearlings and juveniles), and (D) the first four months (120 days) after birth. The colours of the solid lines represent the different transformations (see key) used for the age variable in the growth models. The dotted red horizontal lines show the minimum (3.9m) and maximum (16.2m) body lengths measured in this study. The dashed black horizontal line shows the mean length (14m) of mature whales. The dotted black horizontal line shows the minimum length at sexual maturity (12m) and the two dotted black vertical lines show the age at sexual maturity (5 years) and minimum age at first parturition (6 years) for the South Australian population. n=2,035 measurements from 205 individuals.

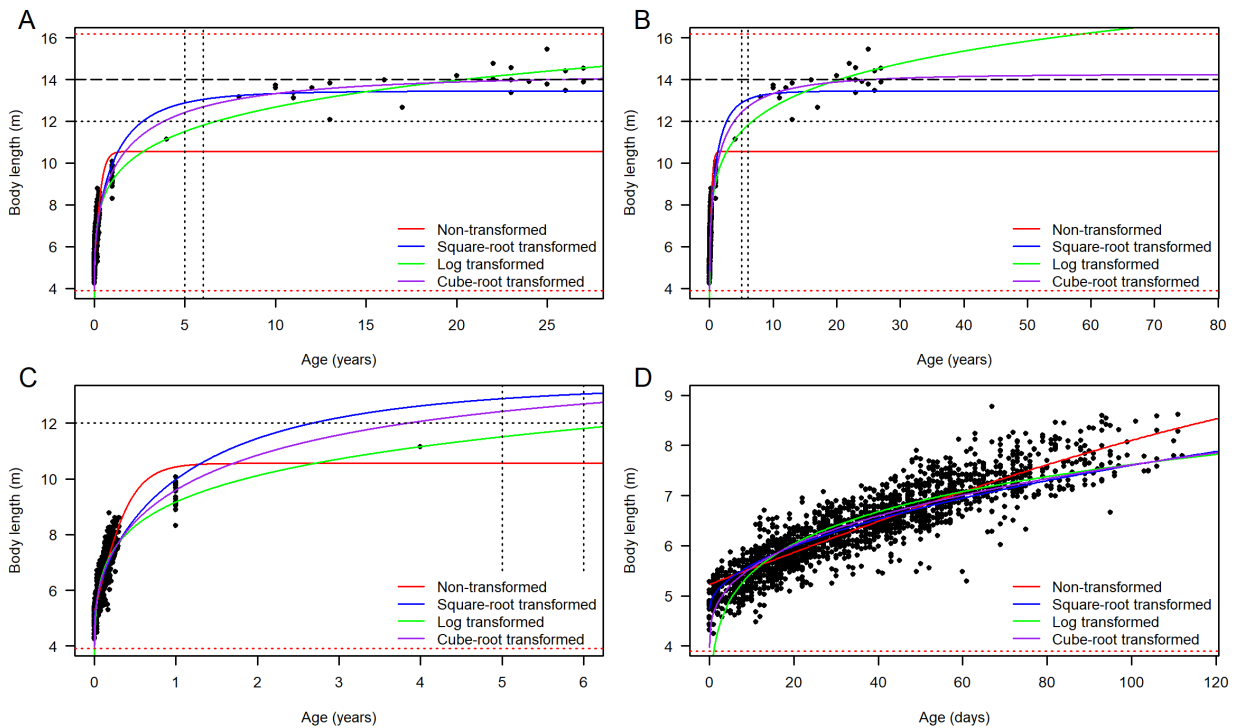


Figure S8. Gompertz growth curves for southern right whales, showing the predicted mean body length of animals across (A) the full age range of the raw data, (B) the full life-expectancy of the species, (C) the age range of immature animals (calves, yearlings and juveniles), and (D) the first four months (120 days) after birth. The colours of the solid lines represent the different transformations (see key) used for the age variable in the growth models. The dotted red horizontal lines show the minimum (3.9m) and maximum (16.2m) body lengths measured in this study. The dashed black horizontal line shows the mean length (14m) of mature whales. The dotted black horizontal line shows the minimum length at sexual maturity (12m) and the two dotted black vertical lines show the age at sexual maturity (5 years) and minimum age at first parturition (6 years) for the South Australian population. n=2,035 measurements from 205 individuals.

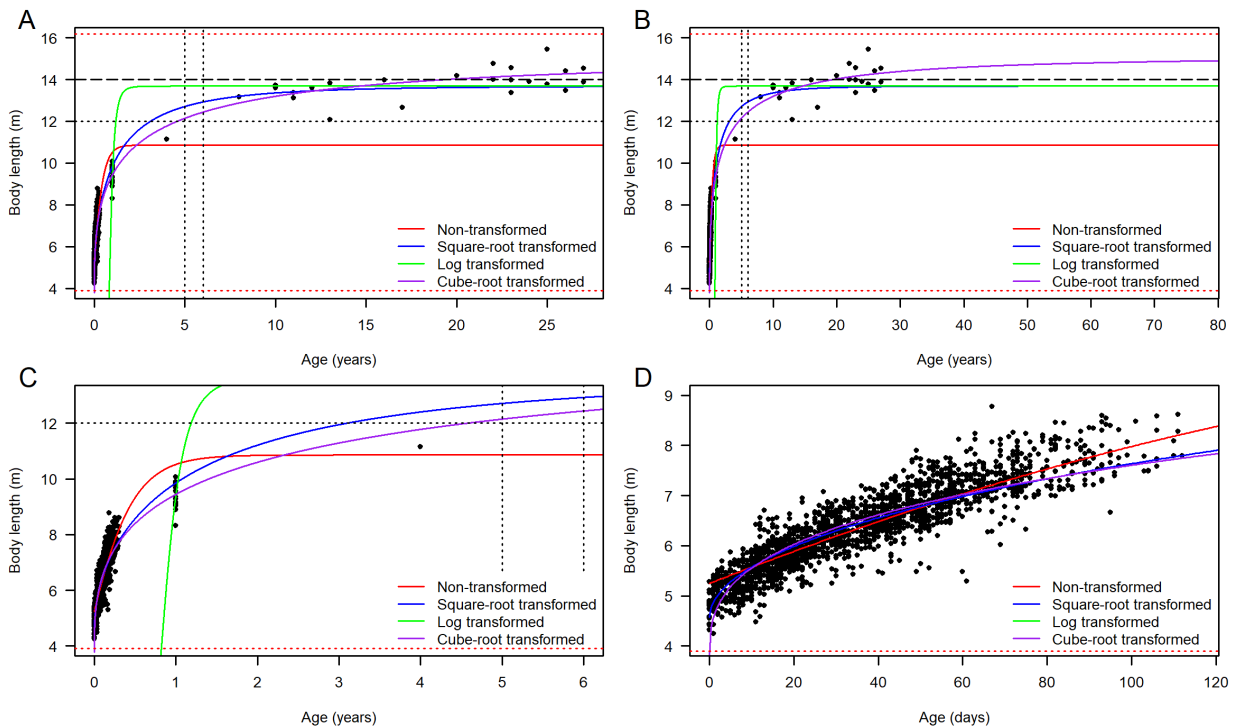


Figure S9. Modified Gompertz growth curves (including linear process) for southern right whales, showing the predicted mean body length of animals across (A) the full age range of the raw data, (B) the full life-expectancy of the species, (C) the age range of immature animals (calves, yearlings and juveniles), and (D) the first four months (120 days) after birth. The colours of the solid lines represent the different transformations (see key) used for the age variable in the growth models. The dotted red horizontal lines show the minimum (3.9m) and maximum (16.2m) body lengths measured in this study. The dashed black horizontal line shows the mean length (14m) of mature whales. The dotted black horizontal line shows the minimum length at sexual maturity (12m) and the two dotted black vertical lines show the age at sexual maturity (5 years) and minimum age at first parturition (6 years) for the South Australian population. n=2,035 measurements from 205 individuals.

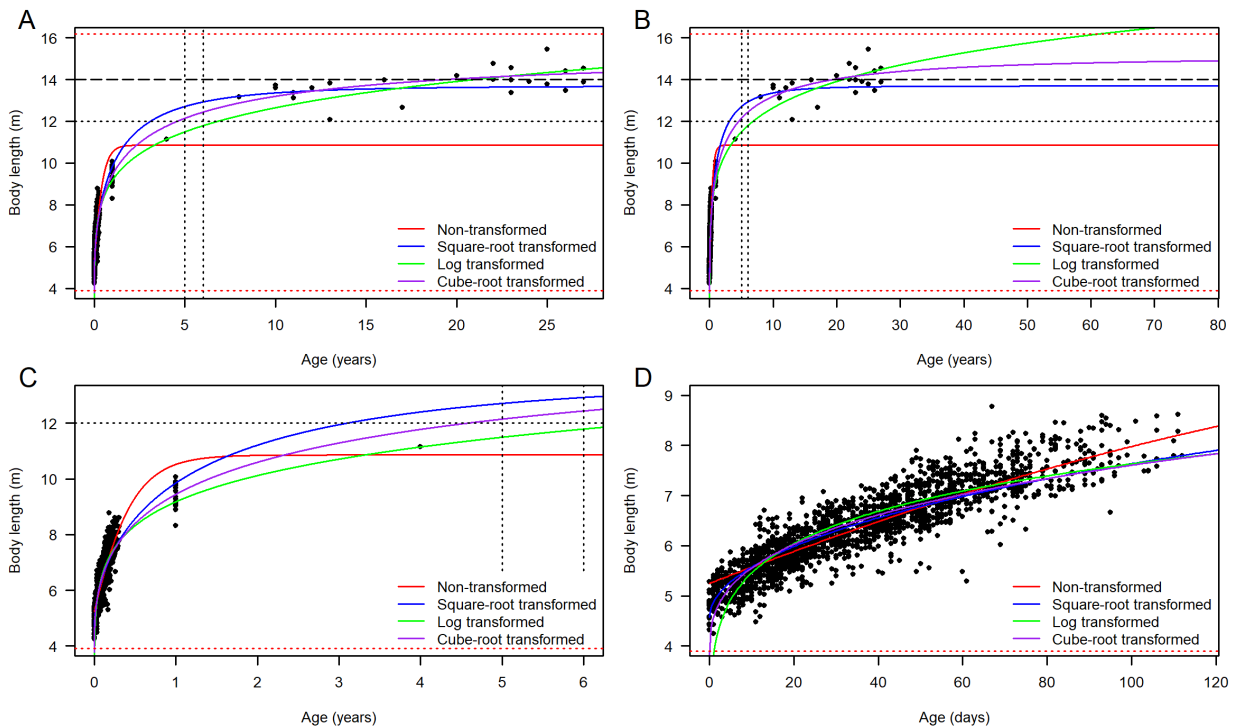


Figure S10. Density distribution of model parameters for the best fitting Richards growth model, showing the results from the bootstrapping simulation (1,000 iterations) where repeated measurements from the same individuals were randomly removed. The vertical blue lines indicate the mean parameter values from the simulation output. The red vertical lines shows the mean parameter values from the original model where repeated measurements were included.

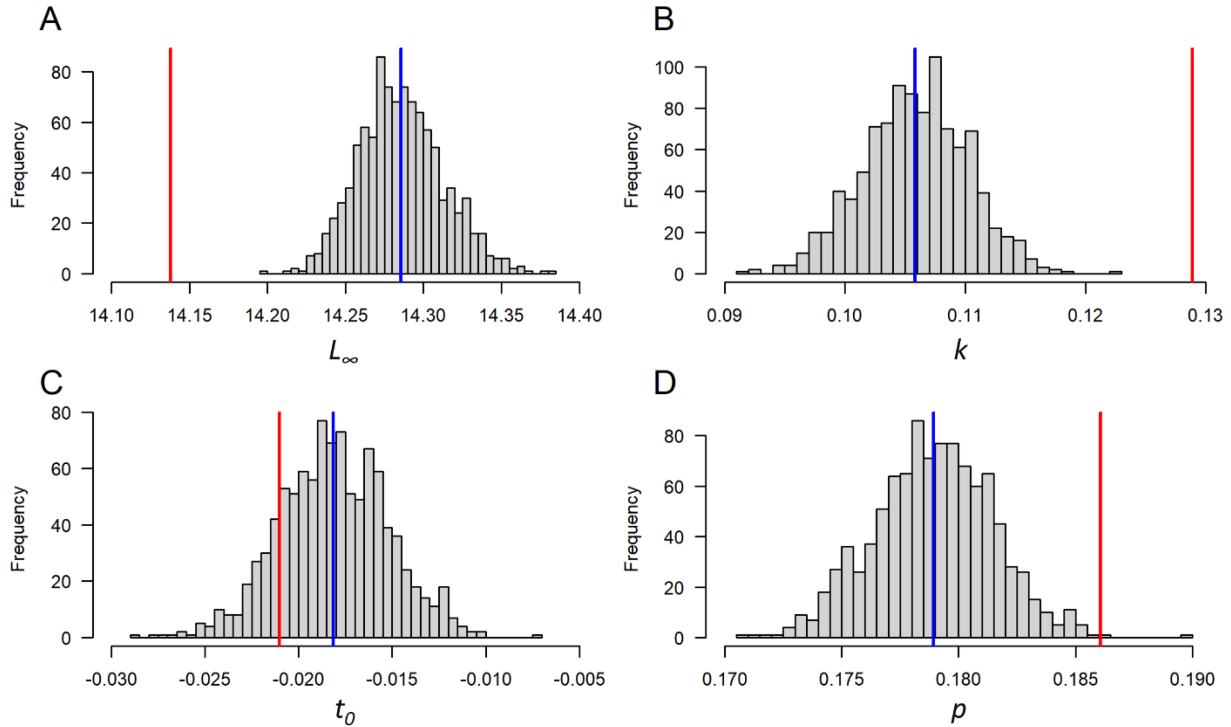


Figure S11. Density distribution of model parameters for the best fitting Richards growth model, showing the results from the bootstrapping simulation (1,000 iterations) where measurement errors (altimeter errors, within photographs errors and between photographs errors) were incorporated into the body length estimates. The vertical blue lines indicate the mean parameter values from the simulation output. The red vertical lines shows the mean parameter values from the original model without measurement errors.

