

Electronic supplementary material

Table S1. Summary of linear model selection results based on minimization of Akaike's information criterion (AIC) for right whale maternal body condition (MBC).

Model	Variables	F	df (among)	df (within)	P	R ²	AIC	ΔAIC
1	MBC ~ Location	4.1	4	157	0.008	0.07	-203.9	36.4
2	MBC ~ Day	37.6	2	159	<0.001	0.19	-230.1	10.2
3	MBC ~ Calf length	31.9	2	159	<0.001	0.17	-225.4	15.0
4	MBC ~ Calf body condition	2.9	2	159	0.089	0.02	-198.8	41.5
5	MBC ~ Maternal length	0.1	2	159	0.761	0	-196.0	44.3
6	MBC ~ Location + Calf length†	14.3	5	156	0.002	0.27	-240.3	0.0
7	MBC ~ Location × Calf length	8.6	8	153	0.002	0.28	-237.3	3.1

† The most parsimonious model (model 6).

Table S2. Summary of linear model selection results based on minimization of Akaike's information criterion (AIC) for right whale calf body condition (CBC).

Model	Variables	F	df (among)	df (within)	P	R ²	AIC	ΔAIC
1	CBC ~ Location†	9.9	3	157	<0.001	0.16	-219.9	0.0
2	CBC ~ Day	12.1	1	159	<0.001	0.07	-207.7	12.2
3	CBC ~ Calf length	0.1	1	159	0.817	0	-196.0	23.9
4	CBC ~ Maternal body condition	2.9	1	159	0.089	0.02	-198.9	21.0
5	CBC ~ Maternal length	0	1	159	0.871	0	-196.0	23.9

† The most parsimonious model (Model 1).

Table S3. Summary of linear model selection results based on minimization of Akaike's information criterion (AIC) for right whale calf body length.

Model	Variables	F	df (among)	df (within)	P	R ²	AIC	ΔAIC
1	CL ~ Location	1.6	3	157	0.183	0.03	420.5	39.7
2	CL ~ Day	24.7	1	159	0.000	0.13	398.2	17.4
3	CL ~ Maternal length	10.2	1	159	0.002	0.06	411.4	30.6
4	CL ~ MBC	31.9	1	159	<0.001	0.17	392.0	11.2
5	CL ~ Maternal length + Day	22.2	2	158	0.001	0.22	383.5	2.7
6	CL ~ Maternal length + MBC†	24	2	158	0.001	0.23	380.8	0.0

Notes: Variable abbreviations: calf body length (CL), Day of Year (Day), maternal body condition (MBC).

† The most parsimonious model (Model 6).

Figure S1. Sensitivity Analysis of Picture Measurement Errors

Output from the picture quality sensitivity analysis showing the density distribution of the mean body condition values for each reproductive class (columns) and location (rows). A lack of overlap between density distributions within the same column indicate a significant difference between locations. The sensitivity analysis consisted of 1,000 bootstrapping iterations. For each iteration and individual whale, a random body length and body width value was drawn from a distribution of values with the means equivalent to the observed body length and width of the individual and the standard deviation based on the body length measurability (1 = 0.0030, 2 = 0.0038, 3 = 0.0068) and body width measurability score (1 = 0.021, 2 = 0.023, 3 = 0.031) estimated by Christiansen et al. (2018).

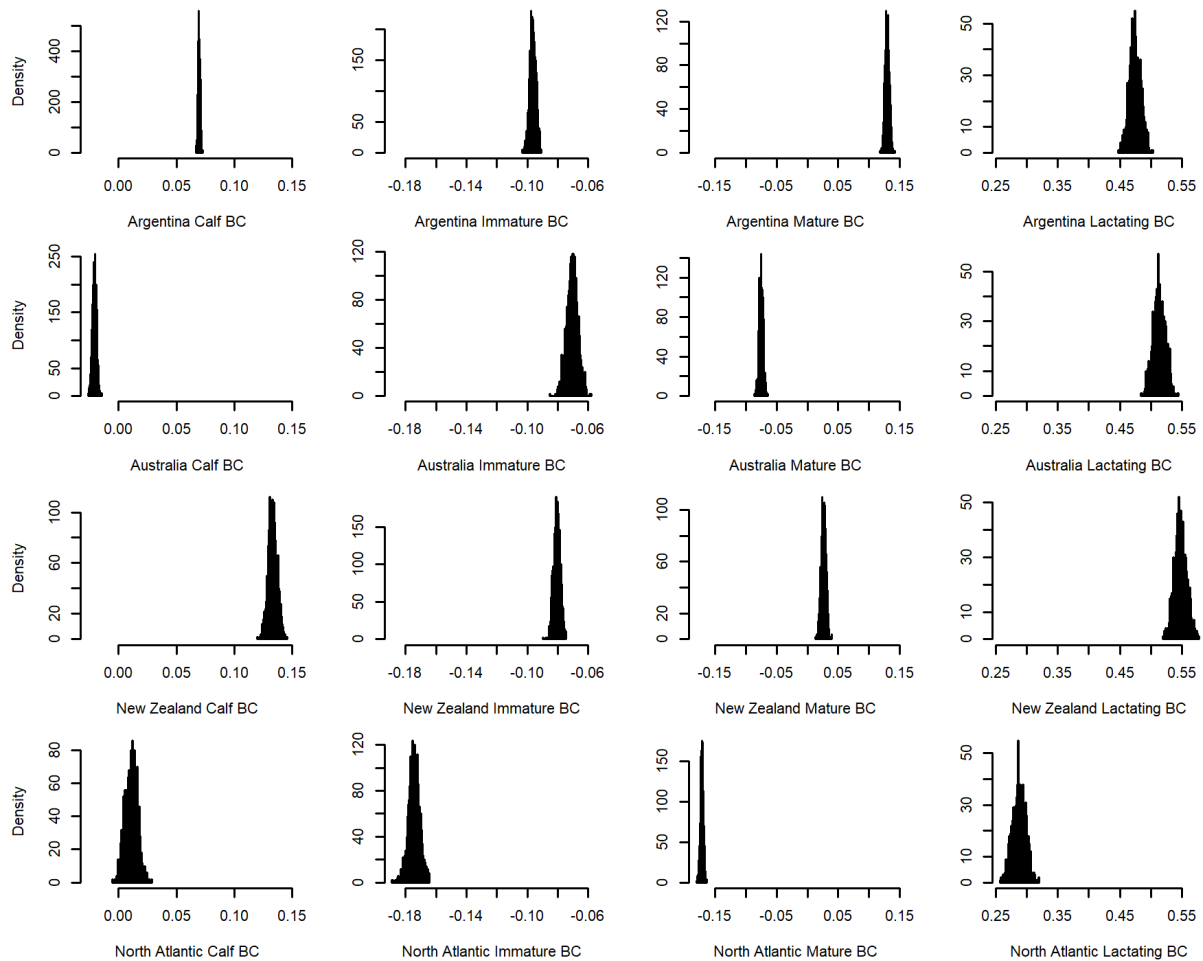


Figure S2. Right Whale Body Width at Different Measurement Sites by Location and Reproductive Class

Mean absolute body width of right whale calves (top-left), immature whales (top-right), mature whales (bottom-left) and lactating females (bottom-right) at different measurement sites. The solid lines represent the fitted values of the linear models for each location (see colour legend). For sample size, see Figure 1 in the main manuscript. BL=Body length.

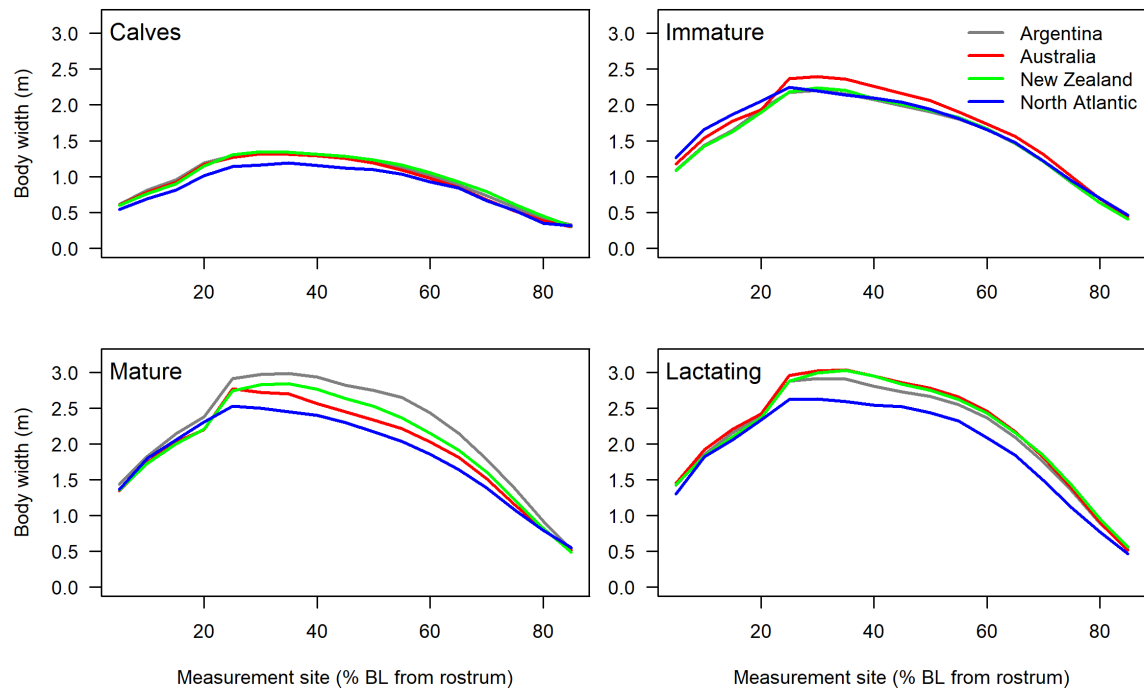


Figure S3. Right Whale Relative Body Width at Different Measurement Sites by Location and Reproductive Class

Mean relative body width (body width/body length) of right whale calves (top-left), immature whales (top-right), mature whales (bottom-left) and lactating females (bottom-right) at different measurement sites. The solid lines represent the fitted values of the linear models for each location (see colour legend). For sample size, see Figure 1 in the main manuscript. BL=Body length.

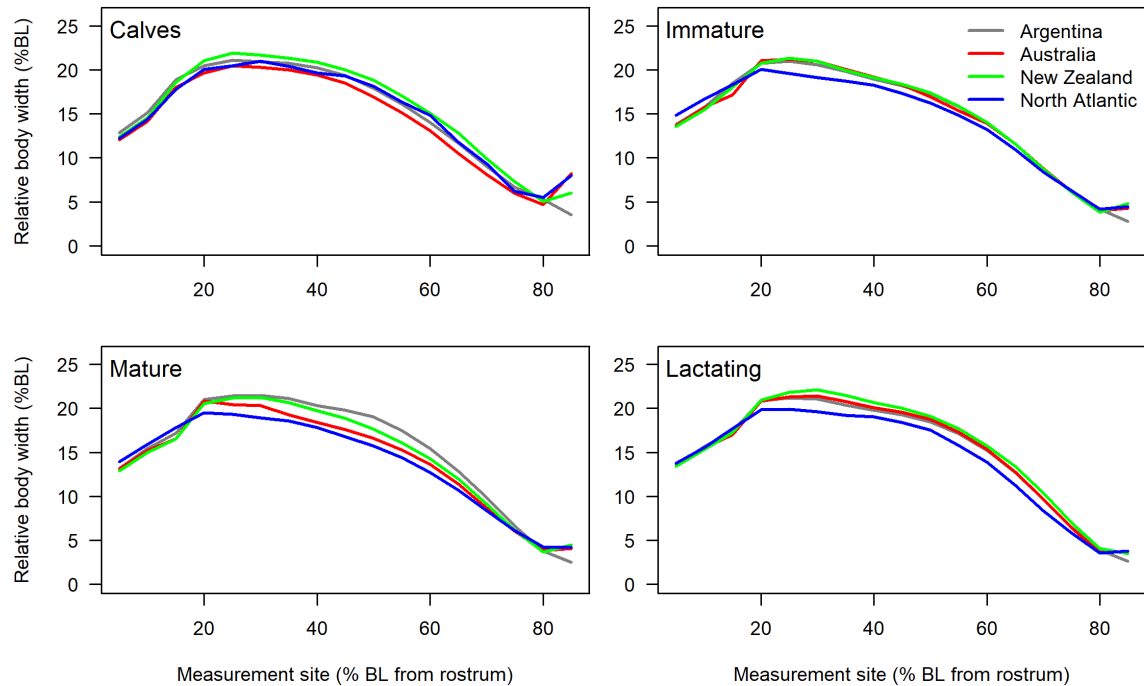


Figure S4. Correlation between Body Condition Indices Calculated from Absolute and Relative Body Morphometrics

Scatter plot showing the correlation ($F_{1,521} = 739902$, $P < 0.001$, $R^2 = 0.999$) between the body condition of right whales calculated from absolute body morphometrics (the residuals of the log-log relationship between body volume, in m^3 , and body length, in meters) and relative body morphometrics (body volume calculated from the relative body width (% of total body length) and length of animals, standardized against the mean body volume of all animals). The dashed red line represent the fitted values of a linear model between the relative and the absolute BCI estimates ($BCI_{Rel} = -0.010 + 0.99 \times BCI_{Abs}$). The high R^2 -value (0.999), an intercept close to 0 and a slope parameter close to 1, indicate that the two approaches yielded almost identical BCIs.

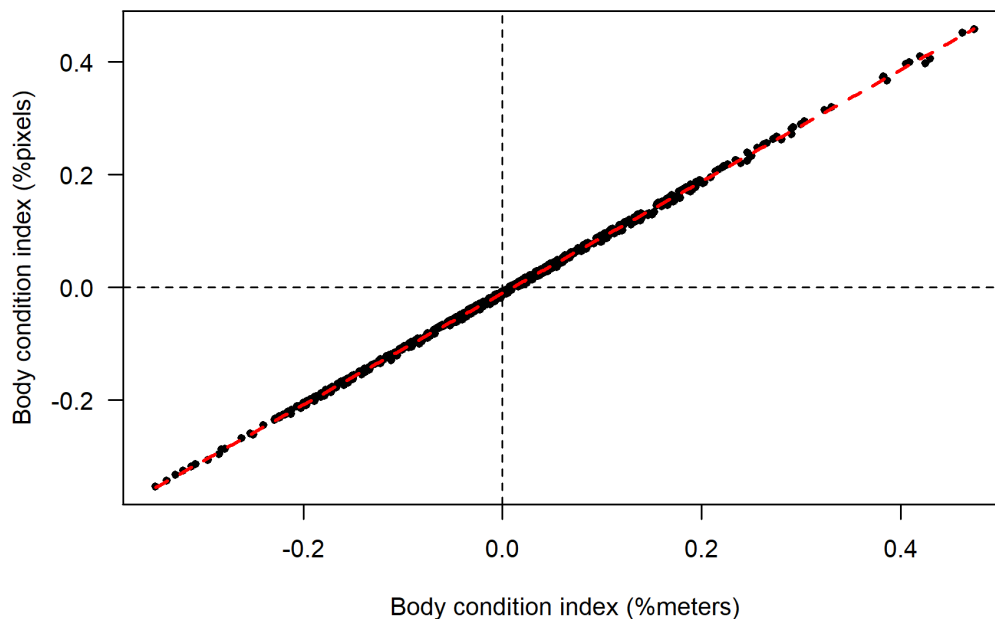


Figure S5. Right Whale Body Condition, Calculated for each Reproductive Class Separately, as a Function of Location

Predicted body condition values from the best fitting models for right whale calves, immature whales, mature whales and lactating females, as a function of location (see colour legend). The body condition index of the whales was calculated separately for each reproductive class, from the residual of the linear relationship between body volume, in m^3 , and body length, in meters, for all the sampled whales for that specific reproductive class. Error bars represent 95 % confidence intervals. All whales were measured on their calving/breeding grounds, except for immature and mature North Atlantic right whales, which were measured on their feeding grounds. For lactating females, the full model also included calf body length as an explanatory variable. In the partial effect plot shown here, calf length was fixed at 6m, which represents the mean body length of calves measured in this study. Sample sizes for all reproductive classes are given in Figure 1.

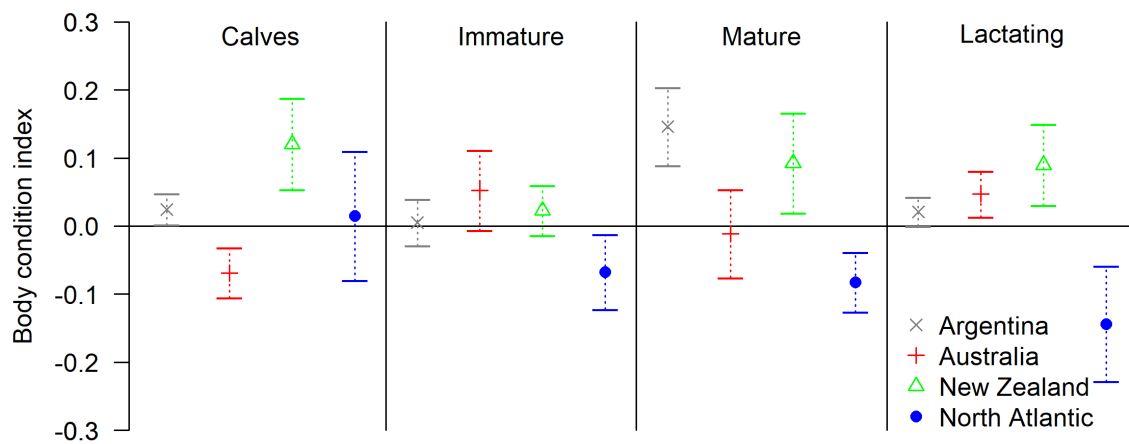


Figure S6. Correlation between Cross-Sectional Body Condition Index and Maternal Body Condition at Time of Parturition

Scatter plot showing the correlation ($F_{1,303} = 614.86$, $P < 0.001$, $R^2 = 0.670$) between the body condition of lactating female right whales in Australia, calculated using two different approaches. In the first approach (y-axis), the body condition index (BCI) of every female ($N = 40$ females) was calculated at every measurement occasion ($N = 305$ measurements) from the log-log relationship between body volume and body length. In the second approach (x-axis) the body volume of each female was calculated at the time of parturition, based on her rate of decline in body volume and the growth rate of her calves, assuming a birth volume of 1.6 m^3 . The body condition of the females at the date of birth (FBC) was then calculated from the relationship between body volume and body length (see Christiansen et al. 2018 for details). The solid lines represent the fitted values of the best fitting linear model ($\text{BCI} = -0.005 + 0.94 \times \text{FBC}$).

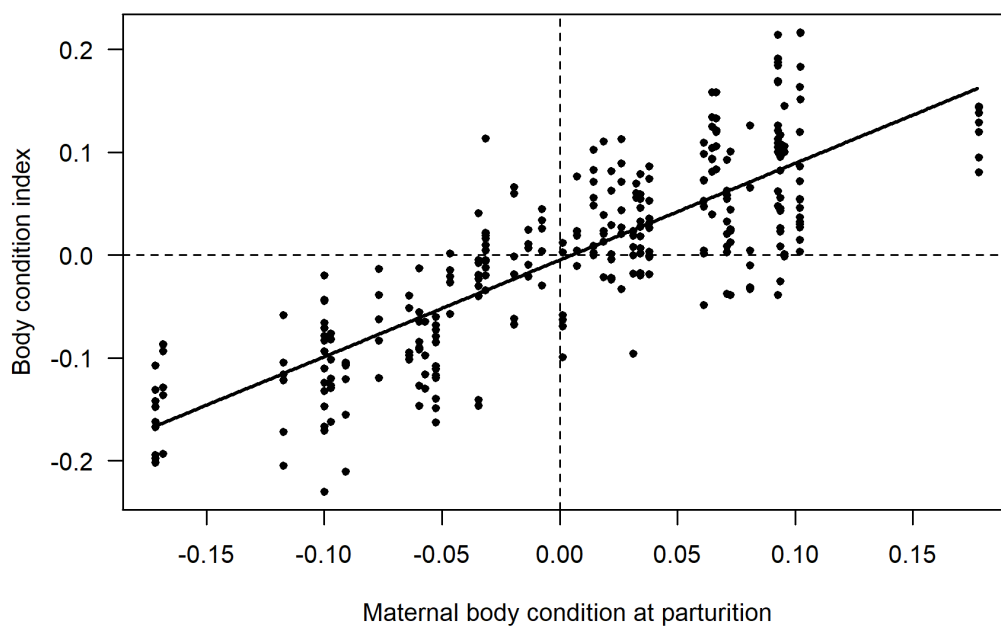


Figure S7. Body Condition of Right Whales by Reproductive Class and Location

Boxplots of body condition of right whale calves (top-left), immature whales (top-right), mature whales (bottom-left) and lactating females (bottom-right) between locations. The sample size for each reproductive class in each location is given by the number below each boxplot. The dotted horizontal lines represents a right whale of average body condition (BCI = 0). All whales were measured on their breeding grounds, except for immature and mature North Atlantic right whales, which were sampled on their feeding grounds. N. Zealand = New Zealand, N. Atlantic = North Atlantic.

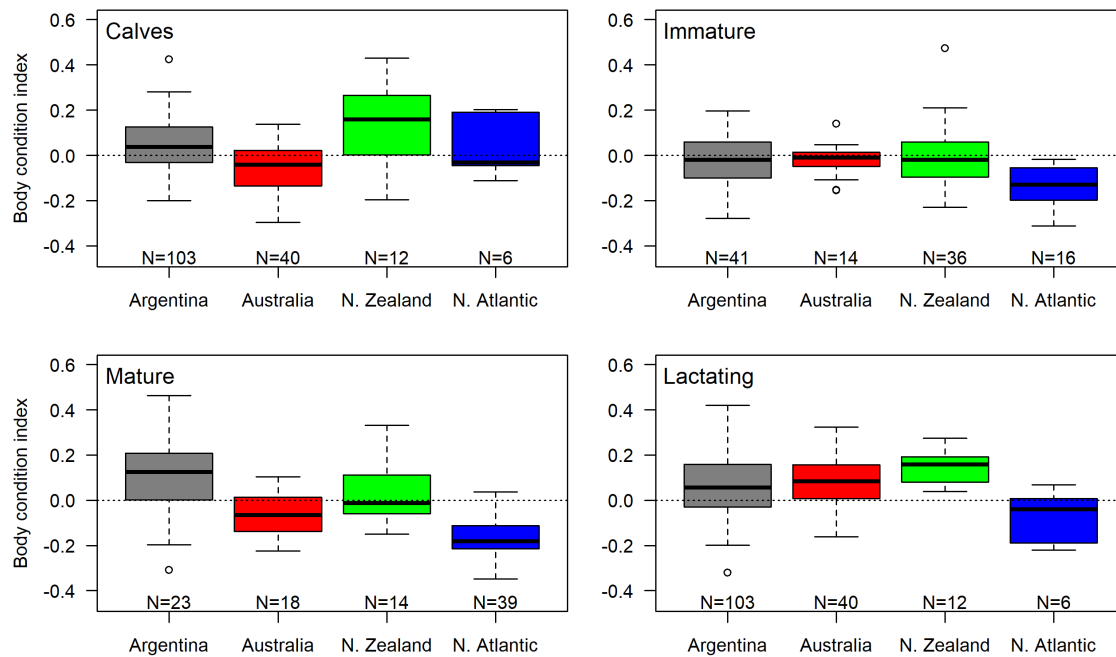


Figure S8. Comparison of Aerial Photographs of Southern Right Whale and North Atlantic Right Whale

Aerial photographs of southern right whale (*Eubalaena australis*) adult in Argentina (top) and a North Atlantic right whale (*Eubalaena glacialis*) adult in Cape Cod Bay, USA, collected by unmanned aerial vehicles. The difference in body condition between the two populations is visible in the relative widths of the two whales.

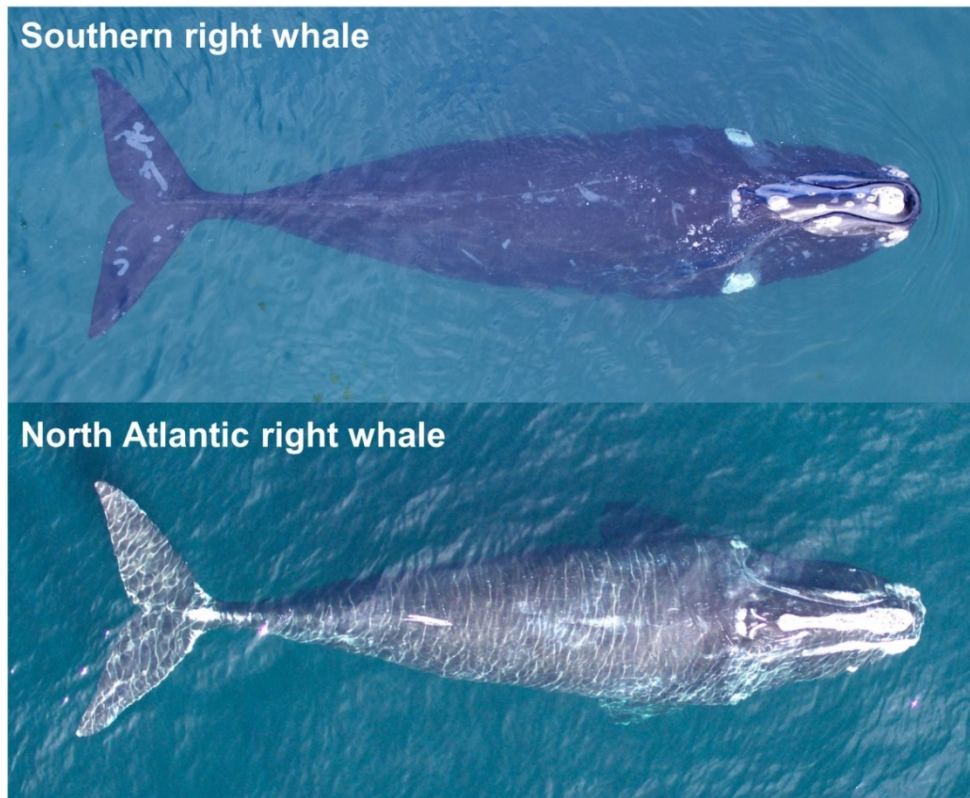


Figure S9. Comparison of Juvenile and Adult Body Lengths between Locations

Boxplots showing the body lengths of (A) juvenile (N = 107) and (B) mature right whales (N = 94) at different locations. All whales were measured on their breeding grounds, except for the North Atlantic right whales, which were sampled on their feeding grounds.

