Supplementary Information

Predictable evolution towards larger brains in birds colonizing oceanic islands

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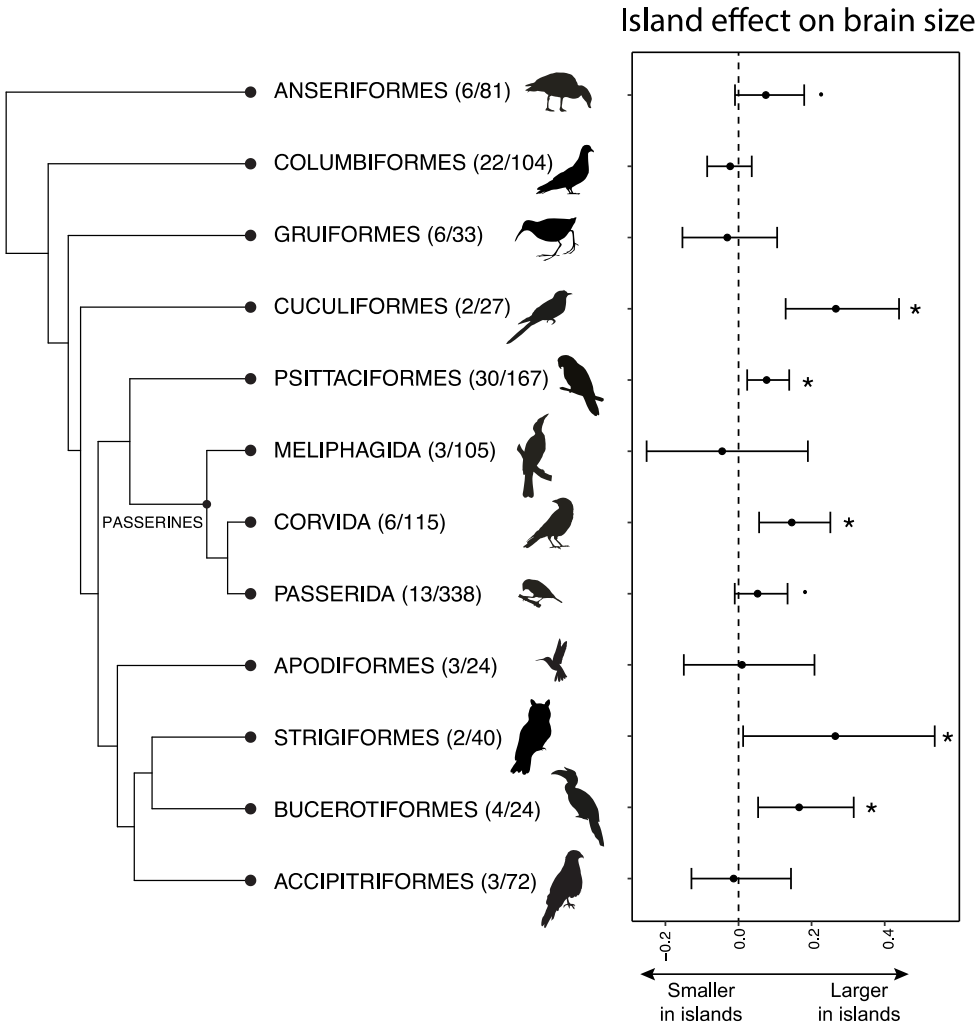
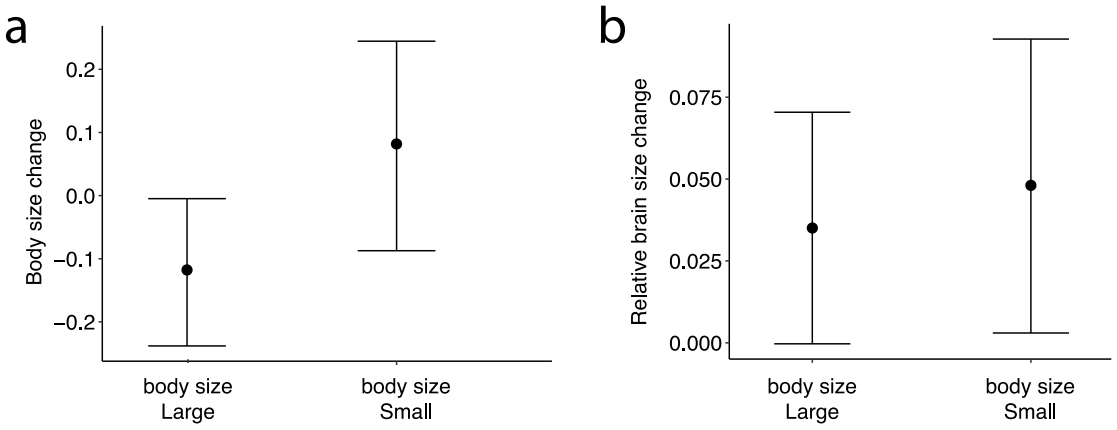
Contents

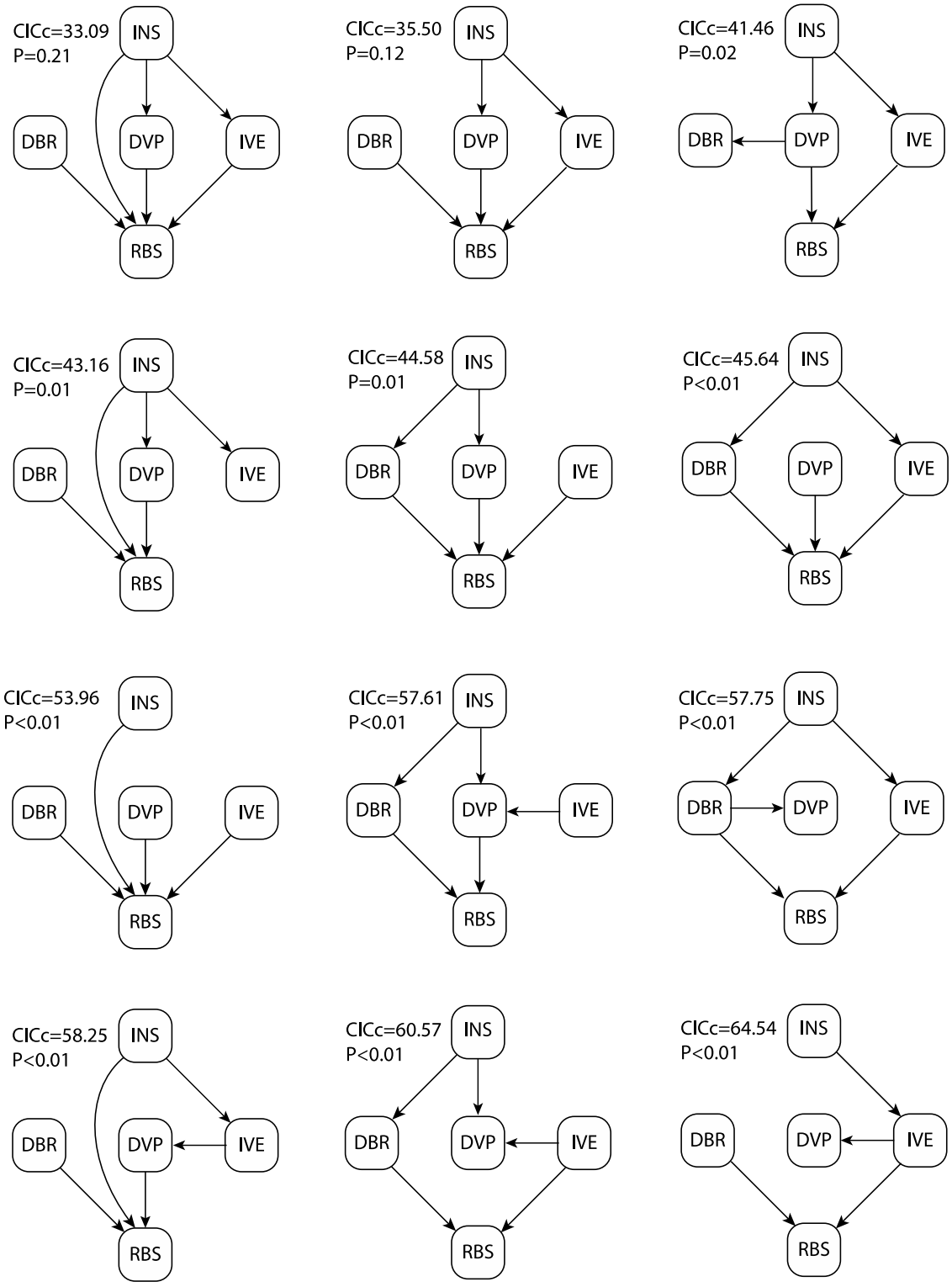
Supplementary Figures



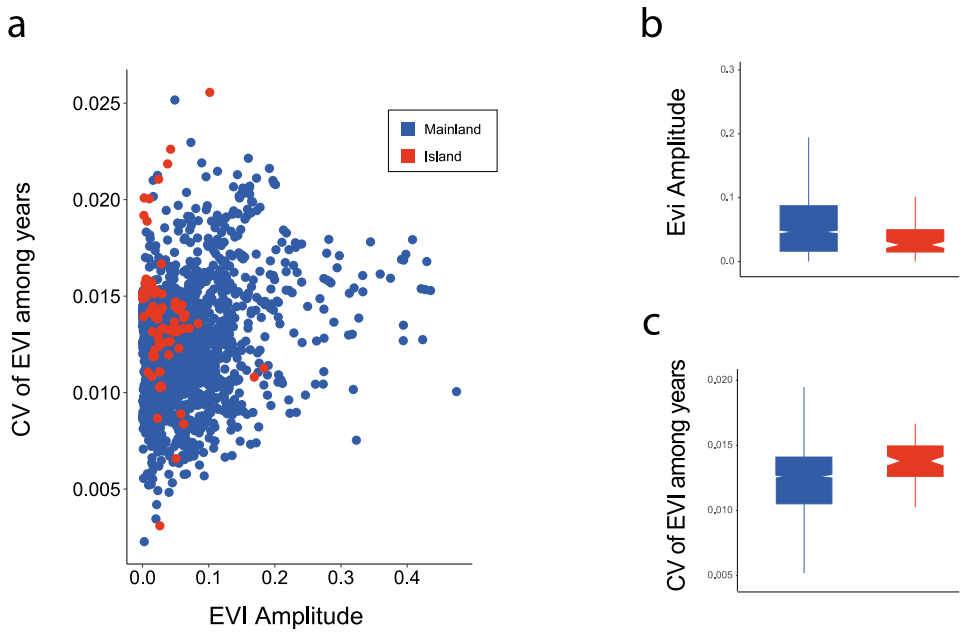
Supplementary Figure 1. Relative brain size differences between island and mainland species in different Avian clades. The posterior mode and 95% CI from a BPMM comparing the relative brain size of island and mainland species in each order are shown. The order Passeriformes was split into infraorders Meliphaga, Corvida and Passerida. (* pMCMC<0.05). The number of island (I) and mainland (M) species measured in each clade is given in parenthesis (I/M). The silhouettes were drawn by FS and are available at PhyloPic (http://phylopic.org).



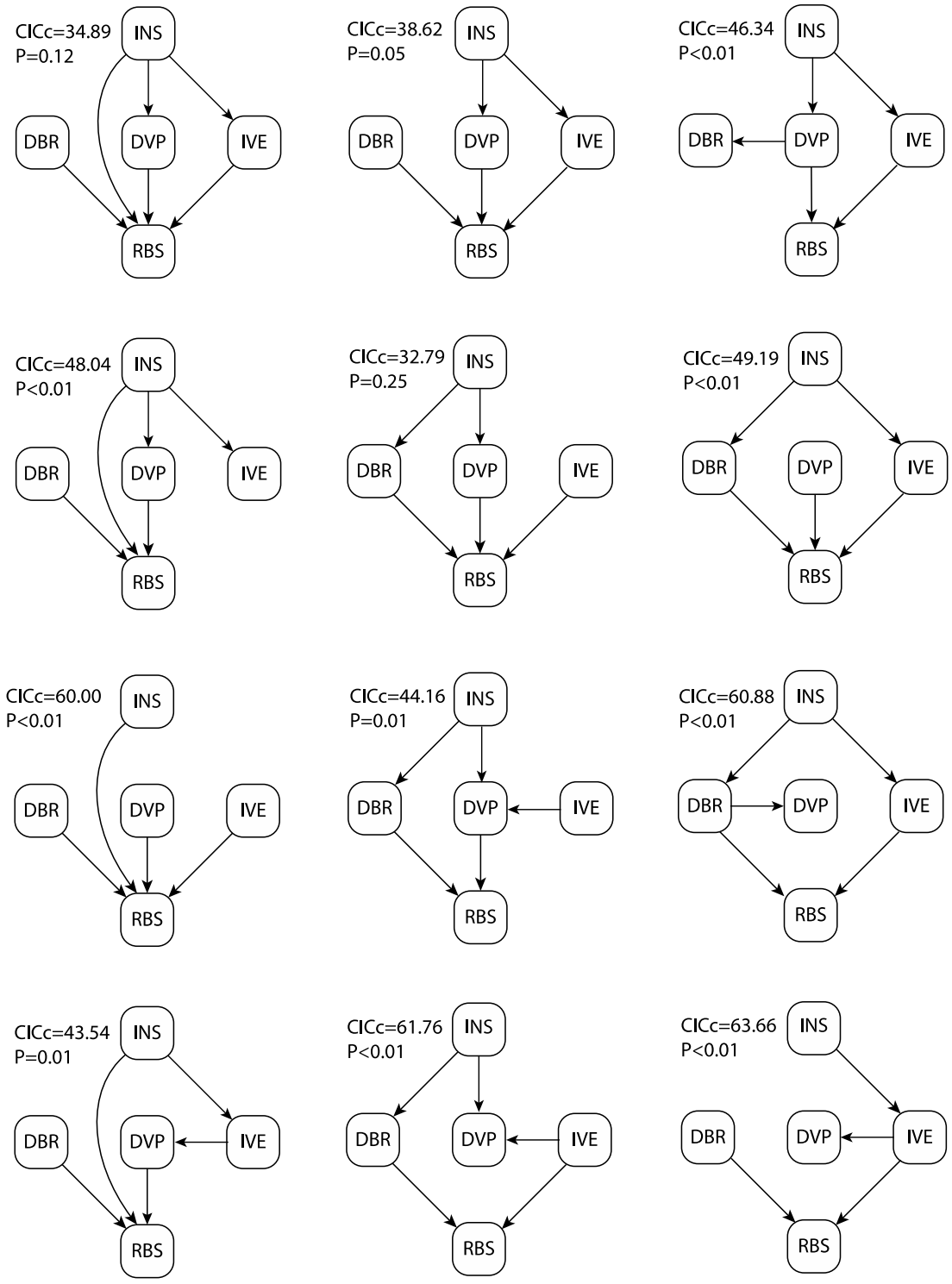
Supplementary Figure 2. Body size evolution does not explain why island species have relatively larger brains than mainland species. Although there exists an interaction between body size and the direction of body size changes (e.g. island rule) (**a**), both large and small birds tend to increase their relative brain size in islands (**b**) compared to the closest mainland sister species. The posterior mode and 95% CI from are shown.



Supplementary Figure 3. Alternative models tested to explore the mechanisms underlying the relationship between relative brain size and island living. INS, Insularity; DBR, Diet breadth; DVP, Developmental period; IVE, Inter-annual variation in environmental productivity; RBS, Relative brain size.

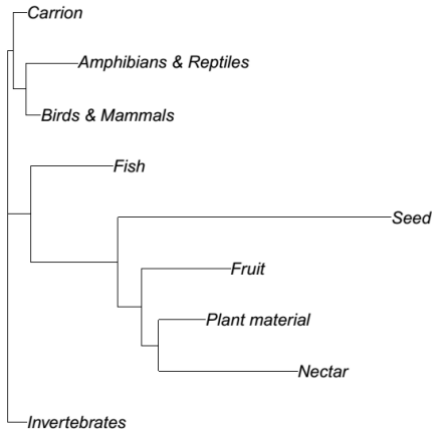


Supplementary Figure 4. Environment variation experienced by island species (red) compared with mainland species (blue). The scatterplot shows the relationship between the amplitude of variation in the enhanced vegetation index (EVI) within years and the coefficient of variation of EVI among years (a). The boxplots show the distribution (mean and percentiles [0.275, 0.25, 0.75 and 0.975]) of the same two variables (b, c) distinguishing island (red) and continental species (blue). Because potential homoscedasticity problems between the two environmental factors, we evaluated them separately in the path models.



Supplementary Figure 5. Alternative models tested to explore the mechanisms underlying the relationship between relative brain size and island living. INS, Insularity; DBR, Diet breadth; DVP, Developmental period; SVE, Seasonal variation in environmental productivity; RBS, Relative brain size.

a



b

	P	G	F	L	W	O	Ref.
Carrion	16	0	0	5	75	4	(1)
Birds & Mammals	15	0	0	4.5	75.5	5	(1)
Amphibians & Reptiles	17.2	0	0	2.7	75.6	4.5	(2)
Fish	15	0	0	8	74.5	2.5	(3)
Invertebrates	17	0	3	5.5	70	4.5	(4-7)
Fruit	2	24	6.5	7	59	1.5	(8-9)
Seeds	9	28	44	3	8	8	(10-12)
Nectar	0	20.5	0	0	79.5	0	(13-14)
Plant material	4.5	26.5	8	3	55	3	(15-16)

Supplementary Figure 6. Resource similarity between food sources, used to calculate diet breadth index (**A**), based on nutritional content for each food item estimated from various sources (**B**) (P: Proteins; G: Carbohydrates- Glucides; F: Carbohydrates-Fiber; L: Lipids; W: Water content; O: Other).

Supplementary Tables

Supplementary Table 1. BPMMS of brain size (log-transformed) as a function of oceanic island living and body size including all the species of our study (model 1), only including species with at least 3 brain measurements (model 2), including interactions (model 3) and confounding factors (model 4). For migratory behaviour and developmental mode, residency and altriciality are respectively the reference levels.

Model	Response	Predictor	Estimate	95% CI	pMCMC
Model 1 (N=1931)	Log(Brain)	Intercept	-2.511	[-2.725; -2.29]	<0.001
		Log (Body)	0.593	[0.583; 0.604]	<0.001
		Insularity	0.055	[0.028; 0.083]	<0.001
Model 2 (N=1525)	Log(Brain)	Intercept	-2.534	[-2.754; -2.323]	<0.001
		Log (Body)	0.601	[0.588; 0.611]	<0.001
		Insularity	0.056	[0.022; 0.089]	0.002
Model 3 (N=1931)	Log(Brain)	Intercept	-2.321	[-2.561; -2.089]	<0.001
		Log (Body)	0.593	[0.583; 0.603]	<0.001
		Insularity	0.046	[0.018; 0.074]	0.002
		Developmental mode (Precocial)	-0.257	[-0.362; -0.135]	<0.001
		Migratory behavior (Migrant)	-0.045	[-0.063; -0.028]	<0.001

Supplementary Table 2. BPMMS of relative brain size as a function of oceanic island living including each insular species and their closest continental taxa and an identifier of each comparison as a random factor in the model. For body size category, big size is the reference level (Nc=Number of comparisons).

Response	Predictor	Estimate	95% CI	pMCMC
Model 1				
Relative brain size (Nc=110)	Intercept	0.190	[-0.128; 0.52]	0.128
	Insularity	0.040	[0.011; 0.071]	0.005
Model 2				
Relative brain size (Nc=110)	Intercept	0.197	[-0.124; 0.541]	0.122
	Insularity	0.036	[-0.005; 0.074]	0.040
	Body category (Small)	-0.010	[-0.097; 0.076]	0.414
	Insularity : Body category (Small)	0.008	[-0.057; 0.078]	0.410
Model 3				
Relative brain size (Nc=110)	Intercept	0.194	[-0.142; 0.53]	0.129
	Insularity	0.039	[0.008; 0.071]	0.008
	Body category (Small)	-0.006	[-0.078; 0.068]	0.439

Supplementary Table 3. BPMMS of body size (log-transformed) as a function of oceanic island living and body size category including each insular species and their closest continental taxa and an identifier of each comparison as a random factor in the model. For body size category, big size is the reference level. (Nc=Number of comparisons).

Response	Predictor	Estimate	95% CI	pMCMC
Log(Body) (Nc=110)	Intercept	6.713	[5.467; 8.083]	<0.001
	Body category (Small)	-0.18	[-0.337; -0.005]	0.022
	Insularity	-1.185	[-1.526; -0.858]	<0.001
	Insularity : Small Body	0.275	[0.000; 0.586]	0.025

Supplementary References

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