Supplementary Information and Figures
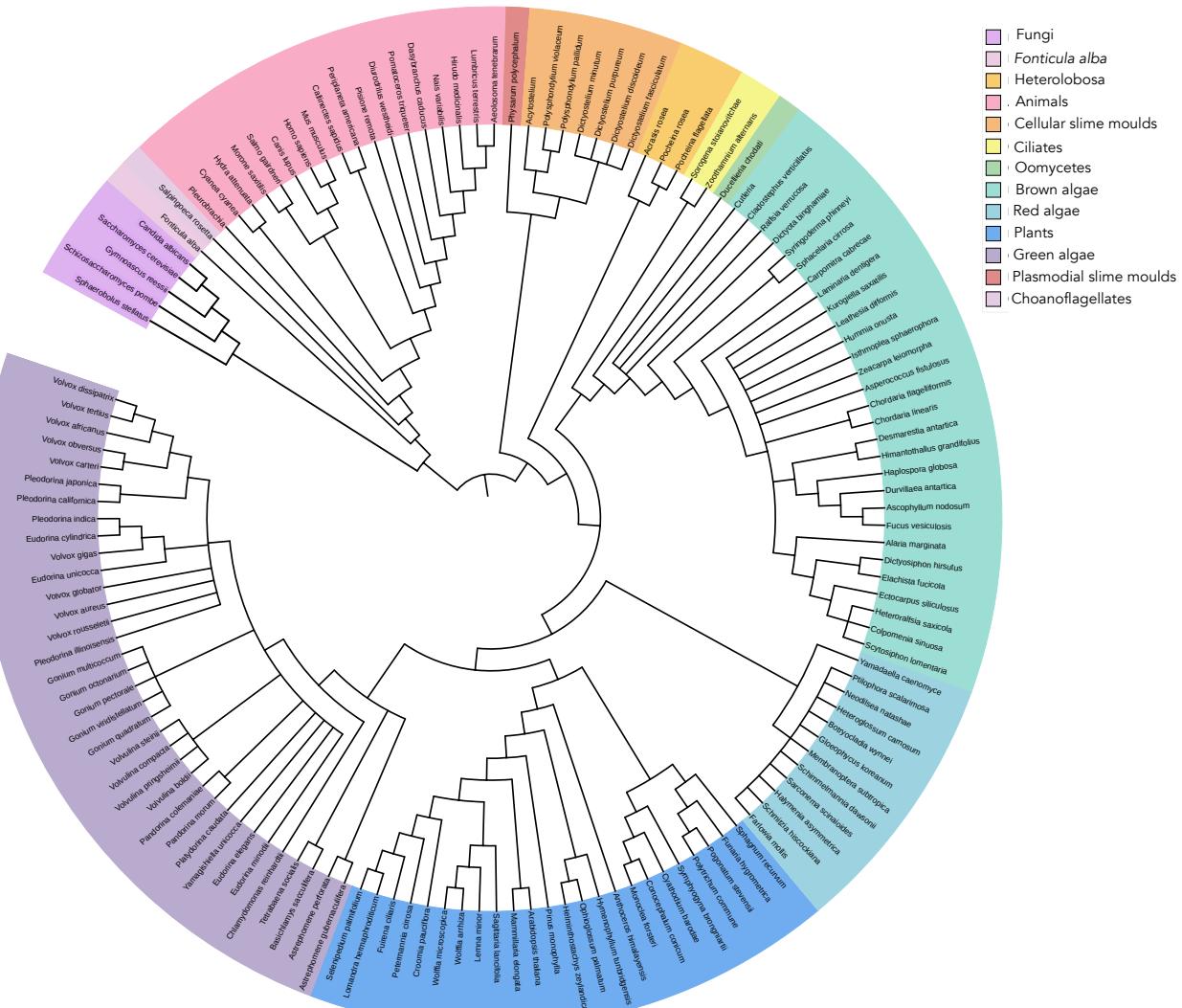

Figure S1: Phylogeny of the multicellular lineages in our dataset. Phylogeny created using the Open Tree of Life and 'rotl' package in R and edited using the online software Interactive Tree of Life. Each lineage that independently evolved multicellularity within the Eukaryotes is highlighted in a different colour and the species that appear in our dataset are given at the tips.

532 **Supplementary Statistical Results Tables**

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534 **Table S1:** Statistical results from Least squares (OLS) and Reduced Major Axis (RMA) Regression

535 on the full dataset, small species and large species. *slopes are significantly different from 0

536

Model	N	Intercept (2.5% - 97.5% confidence intervals)	Slope (2.5% - 97.5% confidence intervals)	R^2	p value
OLS (all)	126	0.03 (-0.09 – 0.15)	0.11 (0.10 – 0.13)	0.64	0.01*
OLS (small)	50	-0.23 (-0.37 – 0.09)	0.21 (0.16 – 0.26)	0.61	0.01*
OLS (large)	76	0.46 (0.08 – 0.83)	0.07 (0.03 – 0.11)	0.15	0.01*
RMA (all)	126	-0.16 (-0.27 - -0.06)	0.14 (0.13 – 0.16)	*NA*	*NA*
RMA (small)	50	-0.38 (-0.52 - -0.27)	0.27 (0.23 – 0.33)	*NA*	*NA*
RMA (large)	76	-0.59 (-1.00 - -0.26)	0.18 (0.15 – 0.23)	*NA*	*NA*

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538 **Table S2 :** Statistical results from the 90% Regression on the small and large species.

Model	N	Intercept (2.5% - 97.5% confidence intervals)	Slope (2.5% - 97.5% confidence intervals)
90% Quantile regression (small)	126	-0.08 (-0.50 – 0.35)	0.25 (0.10 – 0.40)
90% Quantile regression (large)	76	0.44 (0.13 – 0.76)	0.13 (0.10 – 0.17)

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541 **Table S3:** Analysis of the effect of the ancestral environment on the mode of multicellular group

542 formation, taking into account phylogenetic relationships using MCMCglmm.

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Response: Mode of group formation				
Fixed effect		**N**	**Posterior mode (CI)**	**pMCMC**
Ancestral environment	Aquatic		4.80 (1.26 – 7.58)	
	Terrestrial		-1.43 (-4.78 – 0.80)	
	Difference		5.74 (2.91 – 9.79)	0.0008

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546 **Table S4:** Analysis of the effect of the ancestral environment on whether a species is obligately or

547 facultatively multicellular, taking into account phylogenetic relationships using MCMCglmm.

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Response: Obligate or facultative				
Fixed effect		**N**	**Posterior mode (CI)**	**pMCMC**
Ancestral environment	Aquatic		4.04 (2.39 – 5.97)	
	Terrestrial		-2.02 (-4.09 - -0.49)	
	Difference		6.59 (4.29 – 8.72)	< 0.0001

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551 **Table S5:** Analysis of the effect of the current environment, whether the species is obligately or

552 facultatively multicellular and the mode of group formation on the number of cell types and the total

553 number of cells, taking into account phylogenetic relationships using MCMCglmm.

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Response: The number of cell types				
Fixed Effect		**N**	**Posterior mode (CI)**	**pMCMC**
Current environment	Aquatic		-0.11 (-1.56 – 1.70)	
	Terrestrial		0.53 (-0.72 – 2.36)	
	Difference		-0.77 (-1.42 - -0.11)	0.02
Obligate or facultative	Obligate		1.97 (-0.36 – 3.87)	
	Facultative		0.38 (-1.49 – 1.77)	
	Difference		1.68 (0.06 – 3.24)	0.02
Mode of group formation	Clonal		0.11 (-1.75 – 2.33)	
	Non-clonal		0.18 (-1.46 – 1.82)	
	Difference		-0.19 (-1.66 – 1.43)	0.43

Response: Total number of cells				
Fixed Effect		**N**	**Posterior mode**	**pMCMC**
Current environment	Aquatic		9.80 (-5.03 – 20.82)	
	Terrestrial		13.21 (-2.16 – 23.22)	

	Difference		-2.79 (-9.04 – 1.81)	0.12
Obligate or facultative	Obligate		7.95 (0.94 – 12.97)	
	Facultative		3.40 (-1.66 – 9.01)	
	Difference		3.89 (0.65 – 6.62)	0.007
Mode of group formation	Clonal		1.78 (-3.36 – 7.71)	
	Non-clonal		3.23 (-1.83 – 9.15)	
	Difference		1.46 (-1.98 – 4.51)	0.23

Correlations

Number of cell types : Total number of cells	Phylogenetic correlation	0.90 (0.72 – 0.96)	< 0.0001
	Phenotypic correlation	0.56 (0.19 – 0.76)	0.004

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