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Occupancy history influences extinction risk of fossil marine microplankton groups

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	With "gap-omission" approach (implemented in this study)	Without "gap-omission" approach
Foraminifera	2951	2685
Calcareous Nannofossils	3817	3499
Radiolarians	4512	4111
Diatoms	4225	3639

Table S1. The difference in the number of species-bin pairings with usable occupancy change and standing occupancy values for each data set binned to 1 million years, excluding occurrences occurring in bin = 1.

Without Gap-omission LMG					
Occupancy Importance	**Occupancy Change Importance**	**Interaction Importance**	**D^2**	**Bin Size (Ma)**	**Group**
0.0543 ± 0.0098	0.0642 ± 0.0095	0.0458 ± 0.0080	0.164	1.0	F
0.0347 ± 0.0062	0.0443 ± 0.0067	0.0551 ± 0.0079	0.134	1.0	N
0.0144 ± 0.0036	0.0327 ± 0.0053	0.0275 ± 0.0043	0.075	1.0	R
0.0151 ± 0.0043	0.0217 ± 0.0051	NA	0.037	1.0	D

Table S2. LMG relative importance and D^2 values for the NSB data binned to 1-million-year bins, without the gap-omission approach. Shown with standard error.

Simple Completeness Metric				
Bin Size (Ma)	**0.1**	**0.2**	**0.5**	**1.0**
	SCM	**SMC**	**SCM**	**SCM**
Foraminifera	0.434 ± 0.007	0.525 ± 0.009	0.624 ± 0.012	0.698 ± 0.015
Calcareous Nannofossils	0.497 ± 0.006	0.594 ± 0.008	0.711 ± 0.010	0.791 ± 0.012
Radiolarians	0.457 ± 0.006	0.576 ± 0.007	0.726 ± 0.009	0.818 ± 0.010
Diatoms	0.334 ± 0.006	0.434 ± 0.008	0.577 ± 0.011	0.680 ± 0.013

Table S3. Simple completeness metric (SCM, Benton 1987) calculations for each data set at each of the four examined bin sizes. Shown with standard error.

Pearson correlation between total number of occupied Longhurst provinces and total number of occupied cells (corrected for autocorrelation)				
Bin Size (million years)	**0.1**	**0.2**	**0.5**	**1.0**
Foraminifera	0.949	0.951	0.951	0.953
Calcareous Nannofossils	0.968	0.966	0.969	0.968
Radiolarians	0.863	0.865	0.876	0.896
Diatoms	0.895	0.901	0.902	0.909

Table S4. Pearson correlation values between the total number of occupied Longhurst provinces and the total number of occupied cells for each taxonomic group at each bin size. All correlation coefficients were highly significant ($p < 10^{-5}$).

Longhurst Models LMG					
Occupancy Importance	**Occupancy Change Importance**	**Interaction Importance**	**D^2**	**Bin Size (Ma)**	**Group**
0.0542 ± 0.0089	0.0379 ± 0.0063	0.0306 ± 0.0053	0.123	1.0	F
0.0334 ± 0.0060	0.0290 ± 0.0047	0.0394 ± 0.0064	0.102	1.0	N
0.0163 ± 0.0036	0.0152 ± 0.0031	0.0147 ± 0.0028	0.046	1.0	R
0.0238 ± 0.0051	0.0136 ± 0.0035	NA	0.037	1.0	D

Table S5. LMG relative importance and D^2 values for the NSB data binned to 1-million-year bins, using Longhurst province occupancy and its change. Shown with standard error.

Latitudinal Models LMG					
Range Importance	**Range Change Importance**	**Interaction Importance**	**D^2**	**Bin Size (Ma)**	**Group**
0.0245 ± 0.007	0.0140 ± 0.006	NA	0.038	1.0	F
0.0155 ± 0.005	0.0084 ± 0.004	NA	0.024	1.0	N
0.0262 ± 0.006	0.0033 ± 0.002	NA	0.030	1.0	R
0.0357 ± 0.008	0.0116 ± 0.004	0.0079 ± 0.003	0.055	1.0	D

Table S6. LMG relative importance and D^2 values for the NSB data binned to 1-million-year bins, using latitudinal range and its change. Shown with standard error.

First differences correlation				
Group/Bin Size (Ma)	**0.1**	**0.2**	**0.5**	**1.0**
F	0.322	0.256	0.207	0.196
N	0.220	0.167	0.136	0.147
R	0.288	0.239	0.217	0.226
D	0.275	0.248	0.227	0.243

Table S7. Correlation of the first differences of *occupancy* and *occupancy change* for each group at each bin size, calculated to test for multicollinearity.

Model coefficients of mixed-effect models				
Occupancy	**Occupancy Change**	**Interaction**	**Bin Size (Ma)**	**Group**
-4.975	-0.624	-7.860	1	F
-4.419	-0.700	-2.456	0.5	F
-4.863	-0.463	NA	0.2	F
-4.406	-0.389	2.299	0.1	F
-3.275	-0.393	-11.363	1	N
NA	NA	NA	0.5	N
-4.576	-0.194	-4.313	0.2	N
-4.516	-0.522	1.970	0.1	N
-2.063	-0.711	-4.907	1	R
-2.484	-0.598	-2.858	0.5	R
-2.138	-0.922	2.021	0.2	R
-1.902	-0.513	1.443	0.1	R
NA	NA	NA	1	D
-2.028	-0.734	2.096	0.5	D
-1.494	-0.830	2.139	0.2	D
-0.918	-0.799	2.036	0.1	D

Table S8. Model coefficients for the mixed-effects models. Calcareous nannofossils with a bin size of 0.5-million years and diatoms with a bin size of 1.0 million years failed to converge.

Triton Models LMG				
Occupancy Importance	**Occupancy Change Importance**	**Interaction Importance**	**D^2**	**Bin Size (Ma)**
0.0503 ± 0.0128	0.0160 ± 0.0068	NA	0.072	1
0.0297 ± 0.0089	0.0055 ± 0.0037	0.0033 ± 0.0020	0.039	0.5
0.0088 ± 0.0045	0.0036 ± 0.0025	0.0049 ± 0.0031	0.017	0.2
NA	0.0029 ± 0.0025	NA	0.003	0.1

Table S9. LMG relative importance and D^2 values for the Triton data at each bin size. Shown with standard error.

Paired-cell Approach Models LMG					
Occupancy Importance	**Occupancy Change Importance**	**Interaction Importance**	**D^2**	**Bin Size (Ma)**	**Group**
0.0519 ± 0.0090	0.0513 ± 0.0078	0.0452 ± 0.0074	0.148	1.0	F
0.0299 ± 0.0058	0.0336 ± 0.0063	0.0379 ± 0.0070	0.101	1.0	N
0.0073 ± 0.0026	0.0249 ± 0.0042	0.0241 ± 0.0043	0.056	1.0	R
0.0042 ± 0.0026	0.0123 ± 0.0031	0.0086 ± 0.0023	0.028	1.0	D

Table S10. LMG relative importance and D^2 values for the NSB data binned to 1-million-year bins, using the paired-cell approach. Shown with standard error.

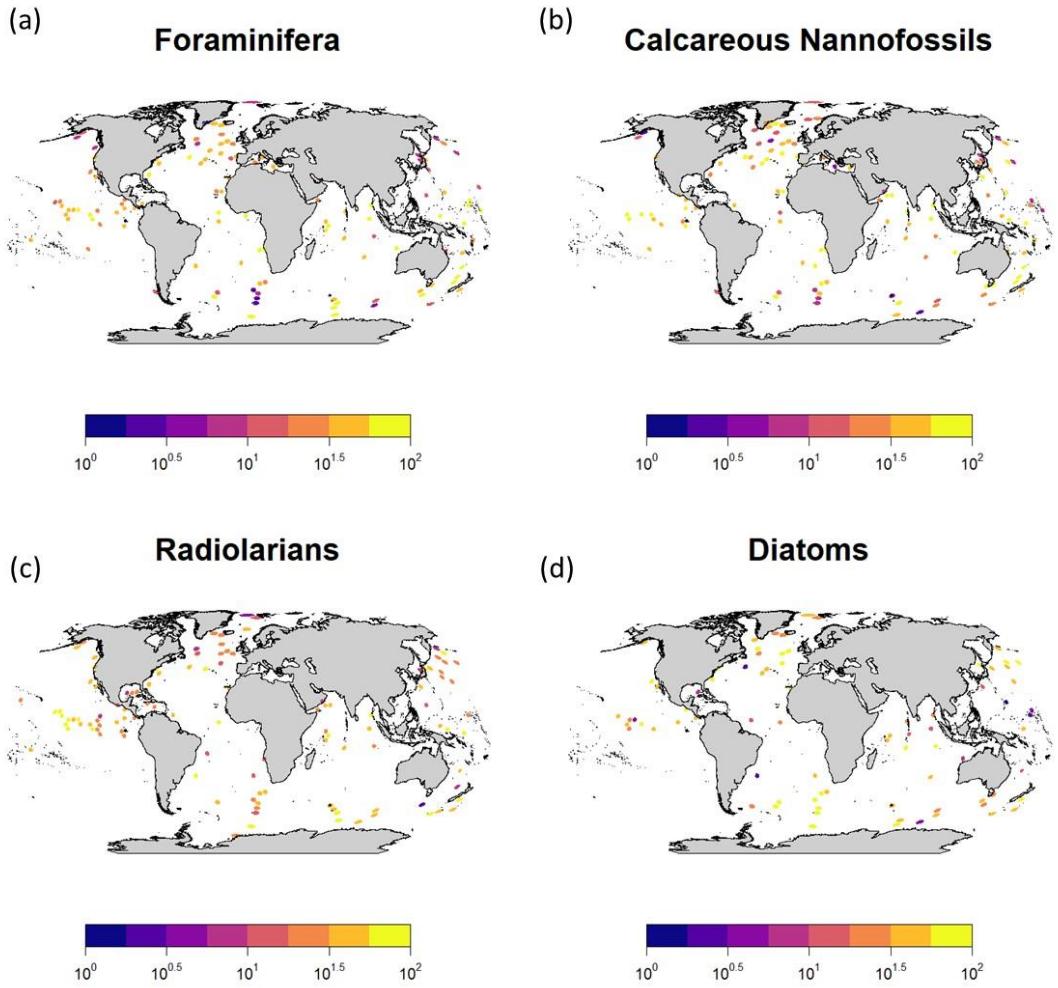

Figure S1. Number of occurrences in each geographic cell, shown for each taxonomic group. Cells assigned according to each occurrence's modern geographic coordinates. White areas correspond to cells without records.

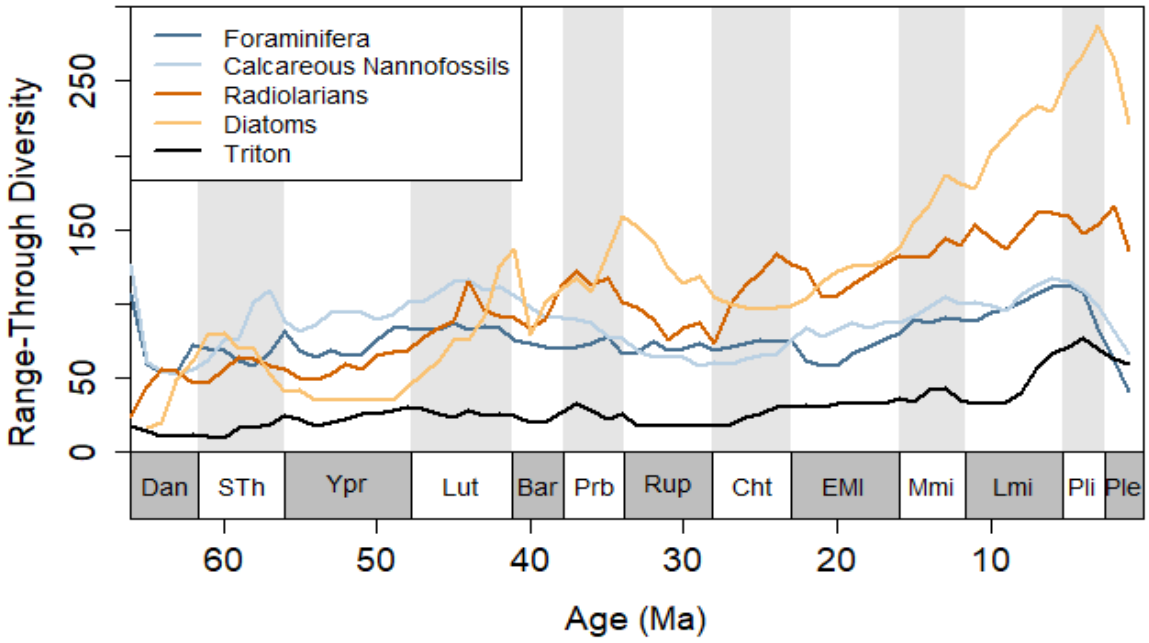

Figure S2. Range through diversity for each of the four NSB datasets and the Triton dataset, using a bin size of 1.0 million years. Notice how the Triton dataset has consistently lower diversity than the other four datasets. Also note the decrease in diversity from the Pliocene to the Pleistocene, suggesting sampling issues at the tops of drill cores.

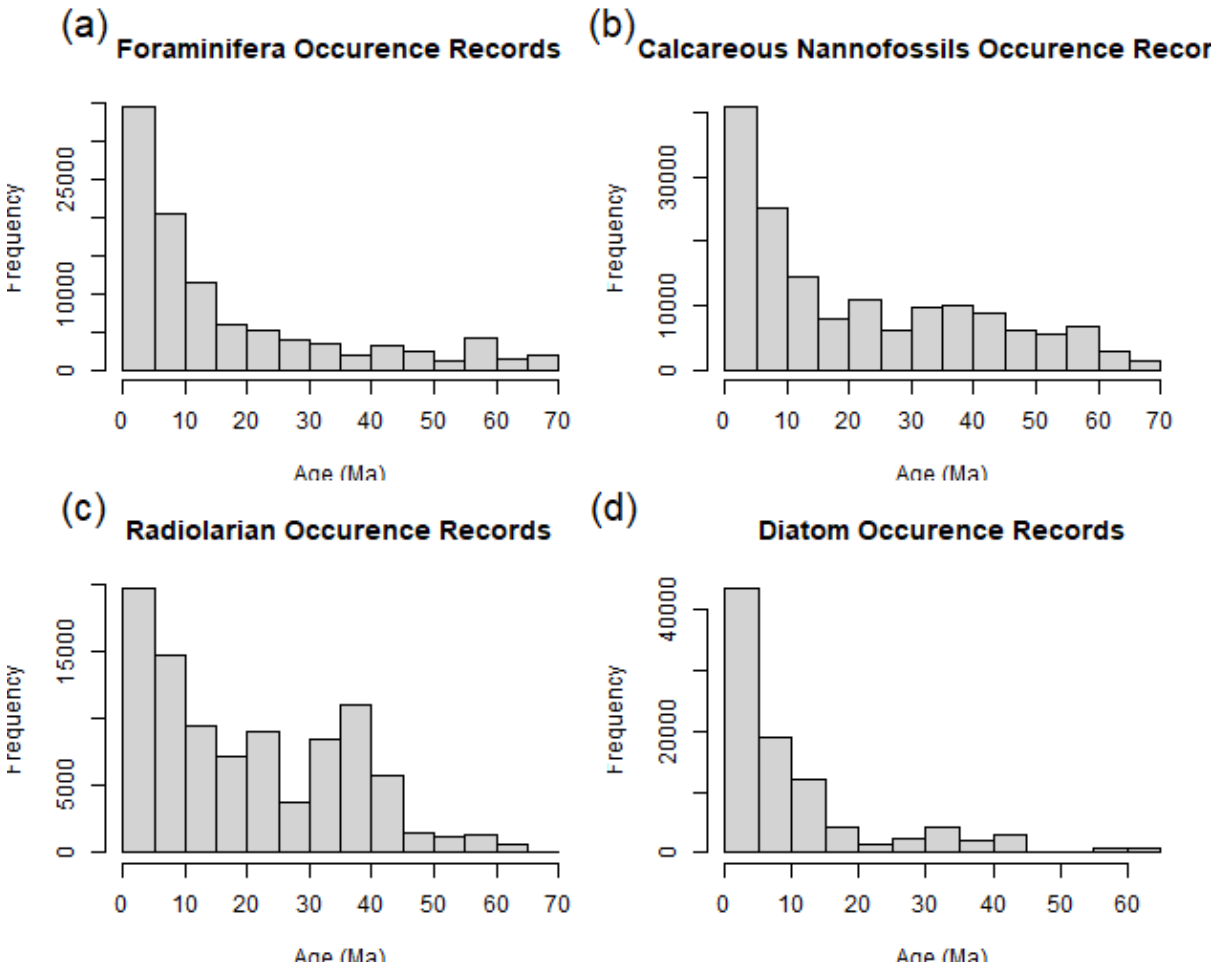

Figure S3. Histogram of occurrence frequency of at each age for each taxonomic group.