MAthesis

Contents

Time Bins with sample sizes

Table 1: Time bins with age range, epoch name, mean age and corresponding sample sizes (on individual, species and genus level)

bin	EpochBins	MeanBins	nIndividuals	nSpecies	nGenera
(0,0.0117]	Modern	0.00585	252	64	18
(0.0117,0.126]	Upper Pleistocene	0.06885	48	16	8
(0.126,0.781]	Middle Pleistocene	0.45350	49	11	6
(0.781,2.59]	Lower Pleistocene	1.68450	73	27	11
(2.59,3.6]	Upper Pliocene	3.09400	23	15	9
(3.6,5.33]	Lower Pliocene	4.46600	29	17	8
(5.33,11.6]	Upper Miocene	8.47000	53	24	9
(11.6,16]	Middle Miocene	13.78900	40	18	11
(16,23]	Lower Miocene	19.50000	25	13	9
(23,50]	Oligocene and Eocene	36.51500	7	5	5

```
## [1] 0
```

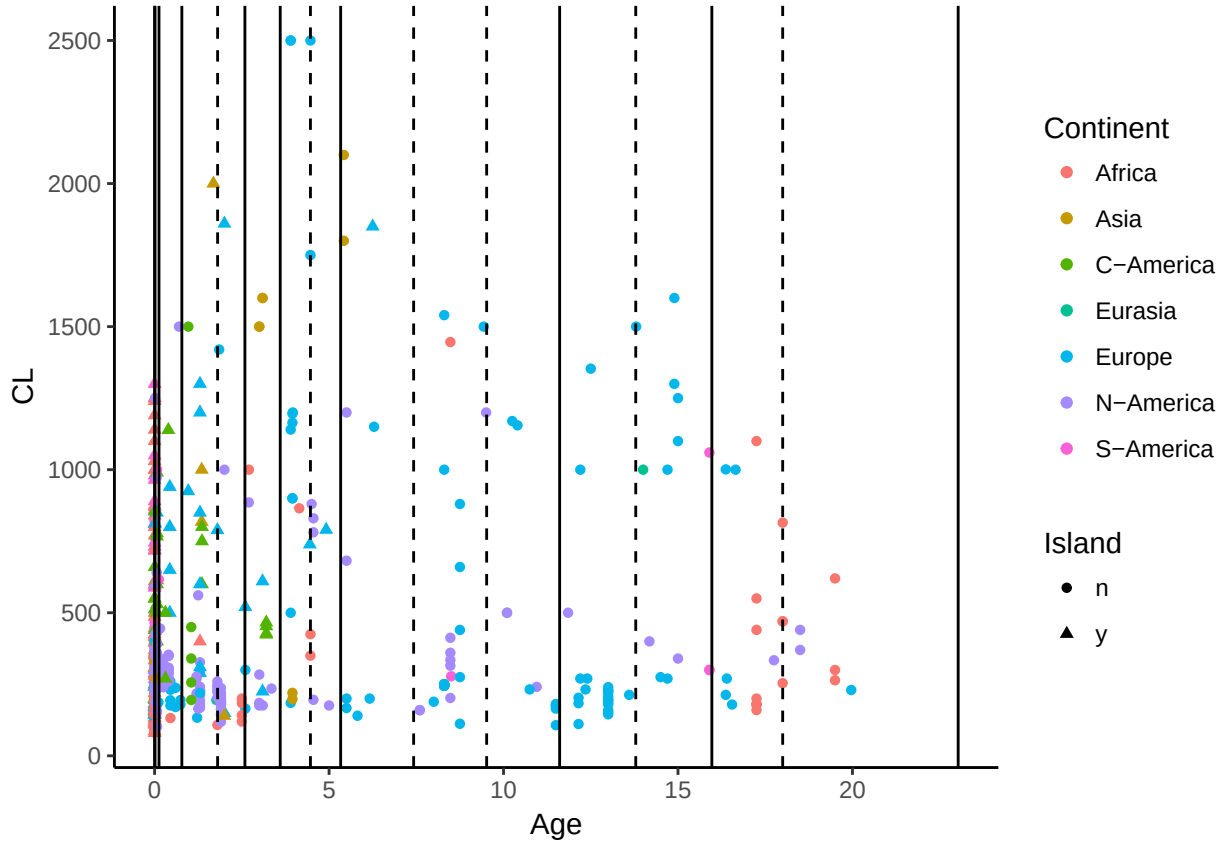


Figure 1: Scatterplot of CL over time, indicating insular (triangle) and continental (circles) and colour indicating continents. Lines indicte bins, dashed line = new bins.

Smaller time bins

Table 2: Smaller time bins with age range, epoch name, mean age and corresponding sample sizes (on individual, species and genus level)

bin	EpochBins	MeanBins	nIndividuals	nSpecies	nGenera
(0,0.0117]	Modern	0.00585	252	64	18
(0.0117,0.126]	Upper Pleistocene	0.06885	48	16	8
(0.126,0.781]	Middle Pleistocene	0.45350	49	11	6
(0.781,1.81]	Lower Pleistocene	1.29350	47	19	11
(1.81,2.59]	Gelasian(LowPleio2)	2.19700	26	10	7
(2.59,3.6]	Upper Pliocene	3.09400	23	15	9
(3.6,4.47]	Lower Pliocene 1	4.02300	19	11	5
(4.47,5.33]	Lower Pliocene 2	4.88900	10	7	4
(5.33,7.42]	Upper Miocene 1	6.37800	12	9	6
(7.42,9.52]	Upper Miocene 2	8.47000	31	14	8
(9.52,11.6]	Upper Miocene 3	10.56200	10	7	5
(11.6,13.8]	Middle Miocene 1	12.69850	22	8	6
(13.8,16]	Middle Miocene 2	14.87950	18	14	10
(16,18]	Lower Miocene 1	16.98500	19	10	8
(18,23]	Lower Miocene 2	20.51500	6	4	4

Maps

fossil occurences of testudinidae

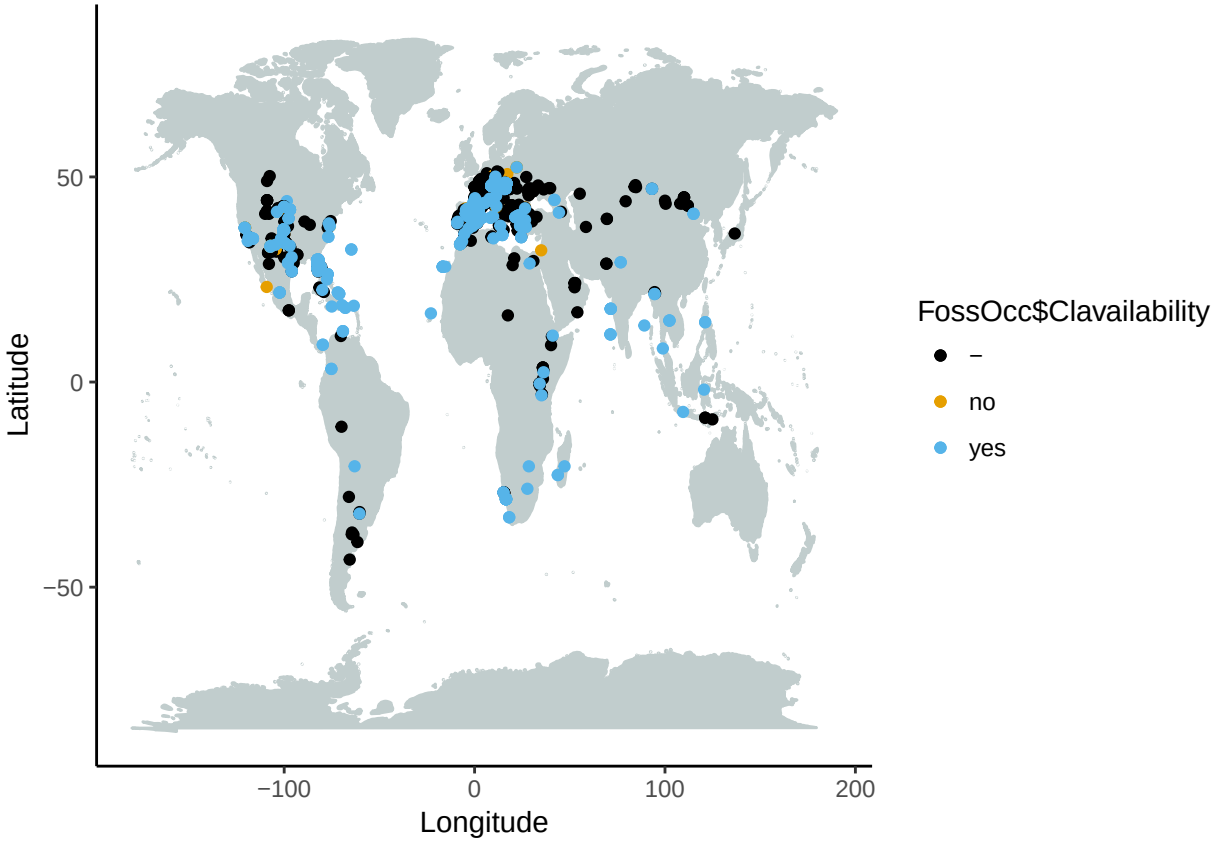


Figure 2: Map displaying all fossil occurrences of testudinids, with color indicating whether relevant literature was available (black if not) and if it was, whether body size data was available or not (yes and no, respectively).

body size of testudinidae

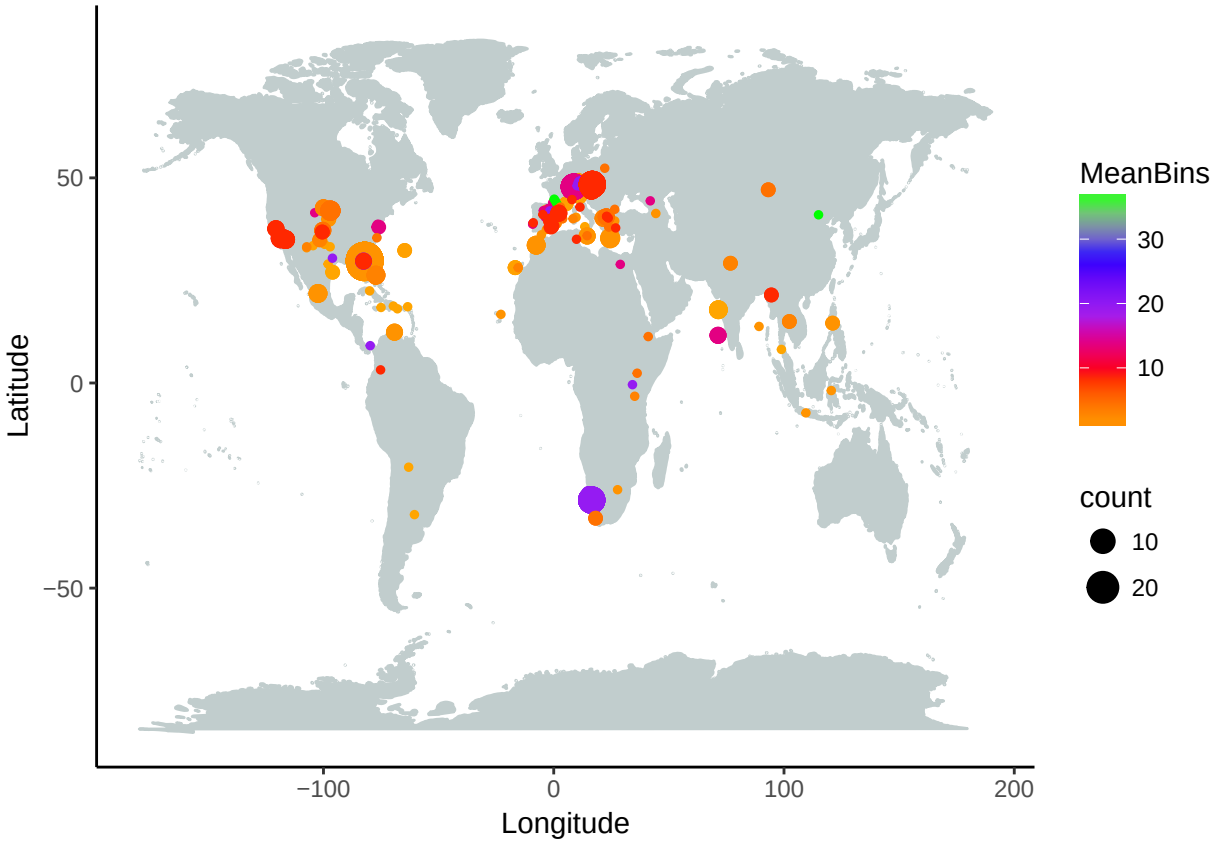
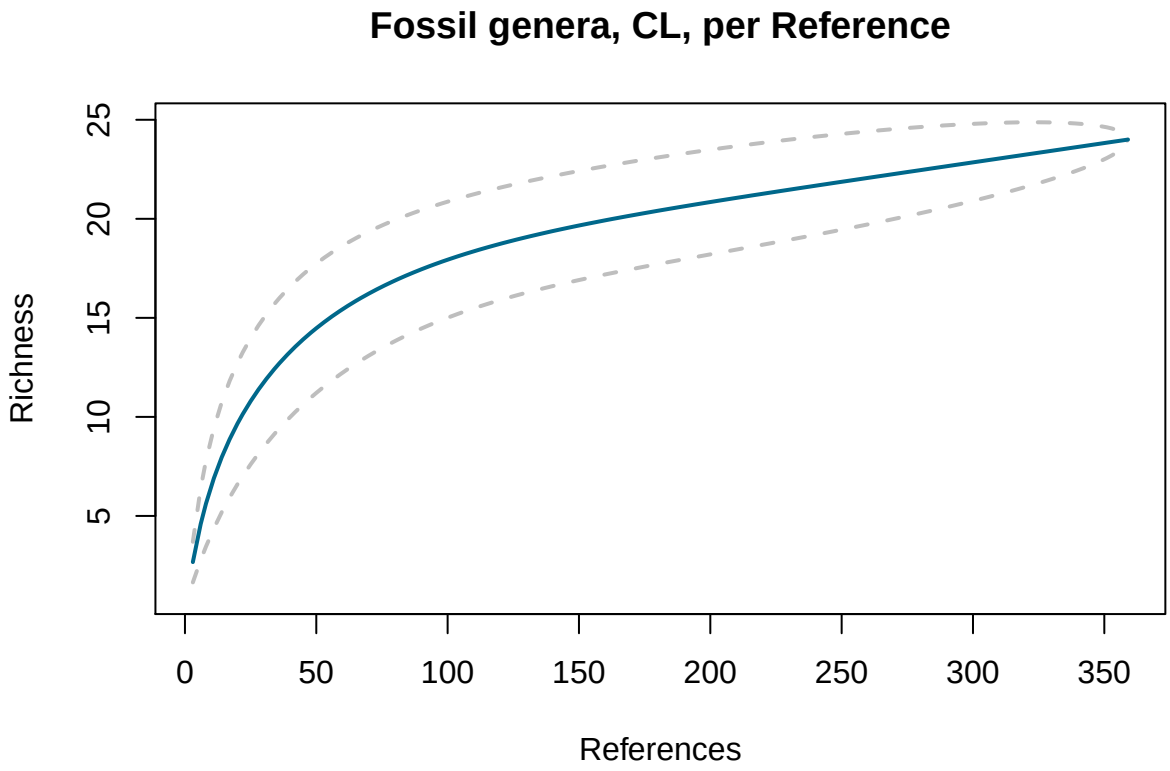


Figure 3: Map displaying all localities for which body size data for testudinids was available in the literature. Size of points denotes sample size, color denotes approximate age.

Sampling Accumulation Curve



Eurasia

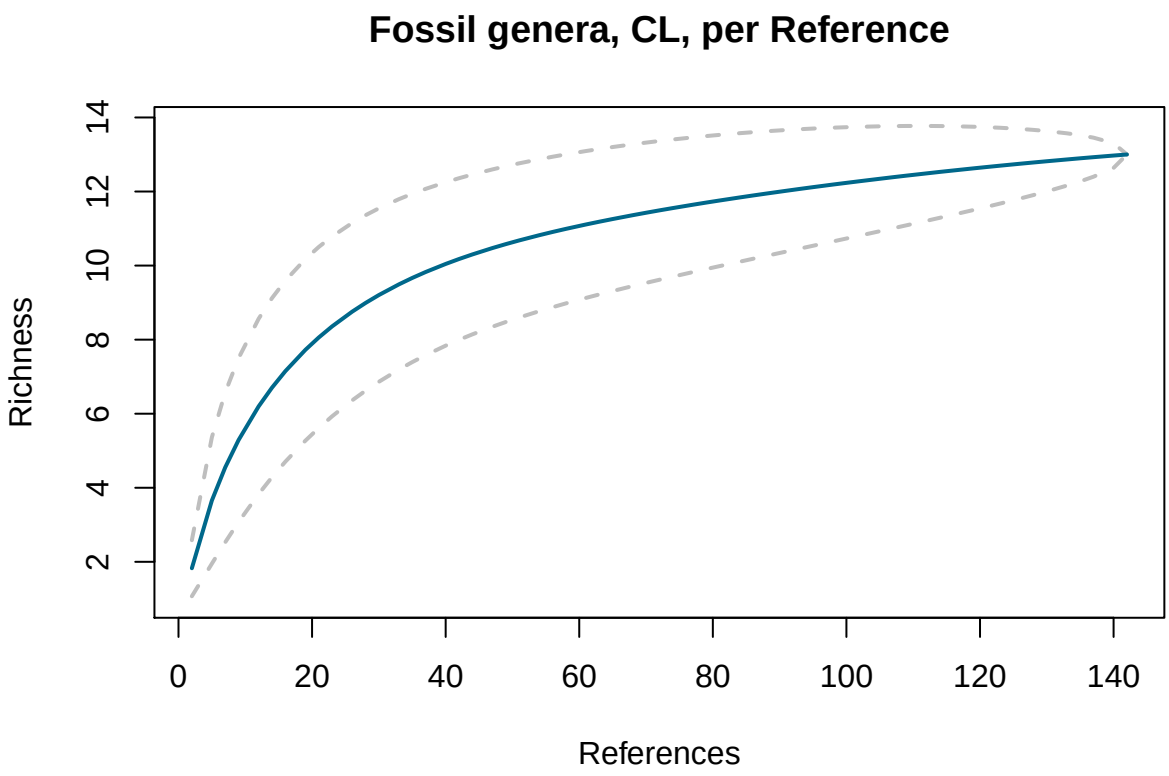


Figure 4: Sampling Accumulation Curve of fossil genera per reference, Eurasia

Histograms

all

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

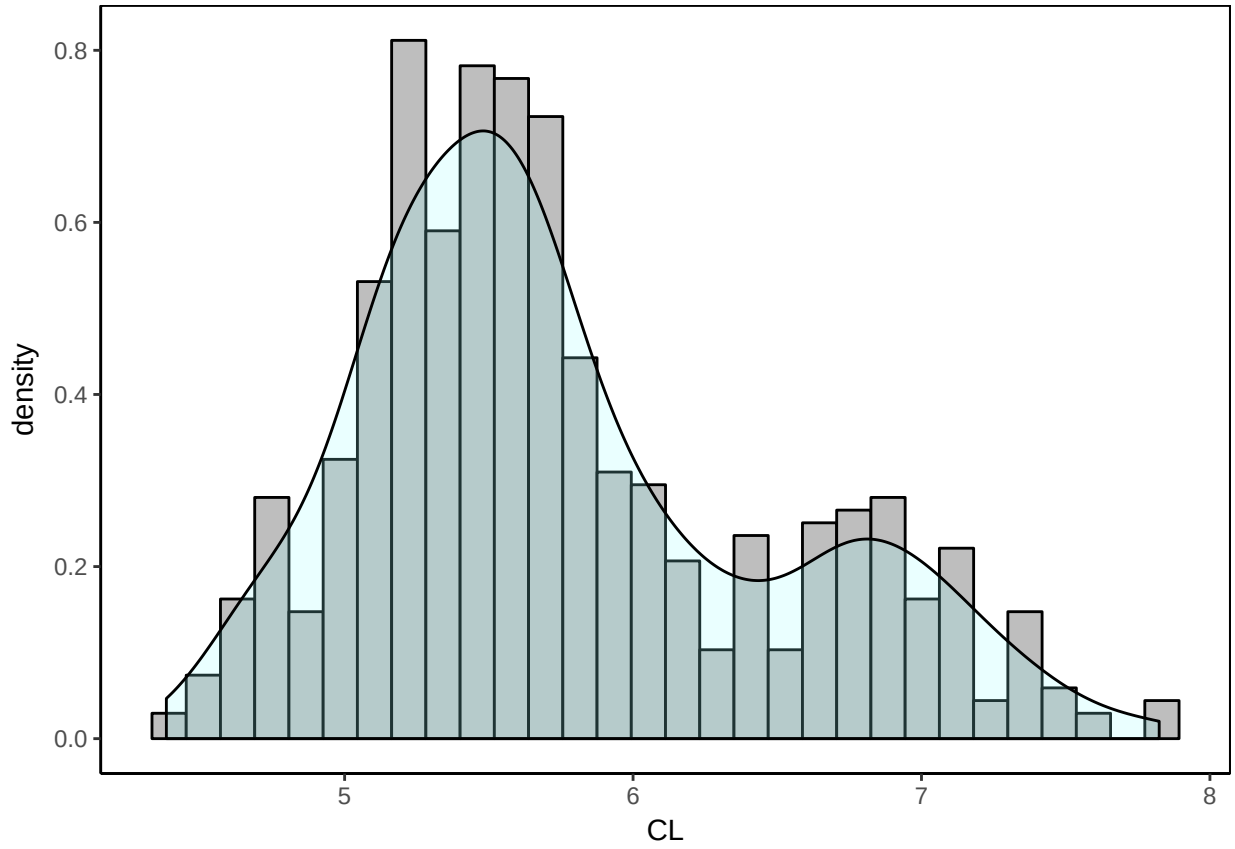
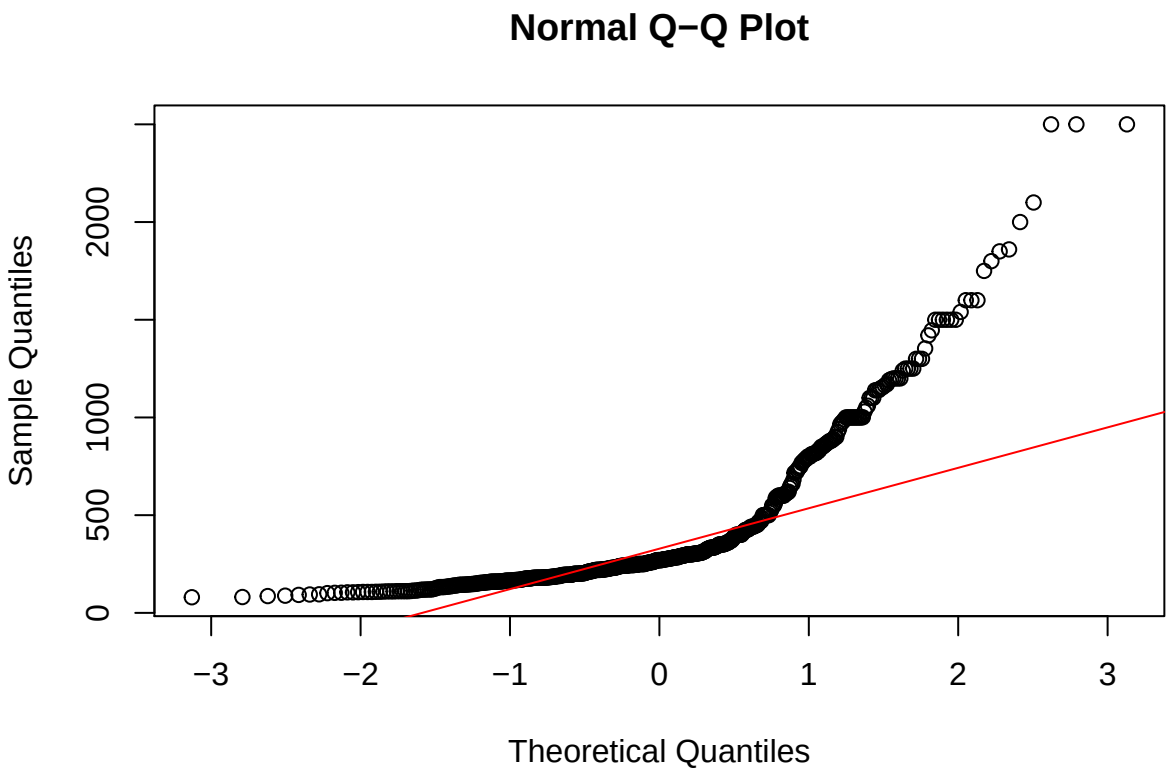
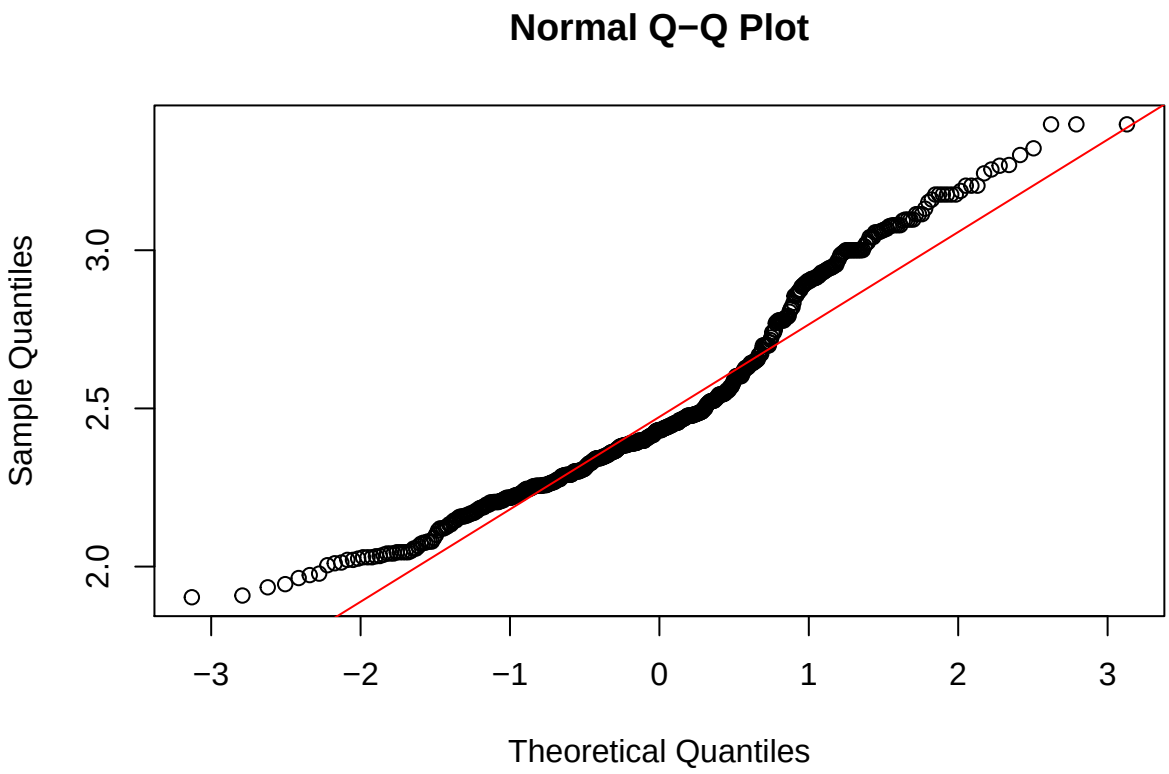


Figure 5: Distribution of body size data, logtransformed, all data.

```
qqnorm(PleiPlioCL$CL); qqline(PleiPlioCL$CL, col=2)
```




```
qqnorm(log10(PleiPlioCL$CL)); qqline(log10(PleiPlioCL$CL), col=2)
```


Normal Q−Q Plot
Sample Quantiles
2.0
2.5
3.0
−3
−2
−1
0
1
2
3
Theoretical Quantiles

per time bin

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

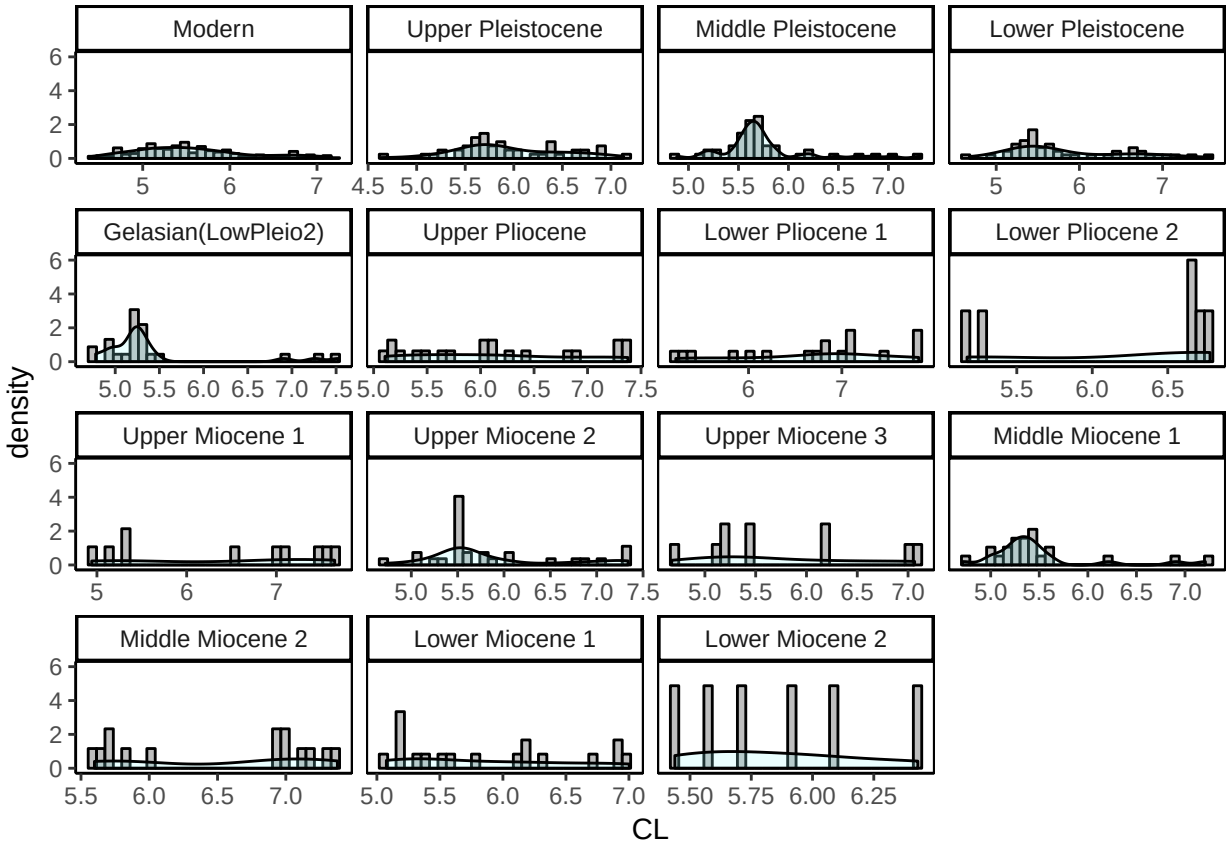


Figure 6: Distribution of body size data per time bin, logtransformed.

modern vs. fossil

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

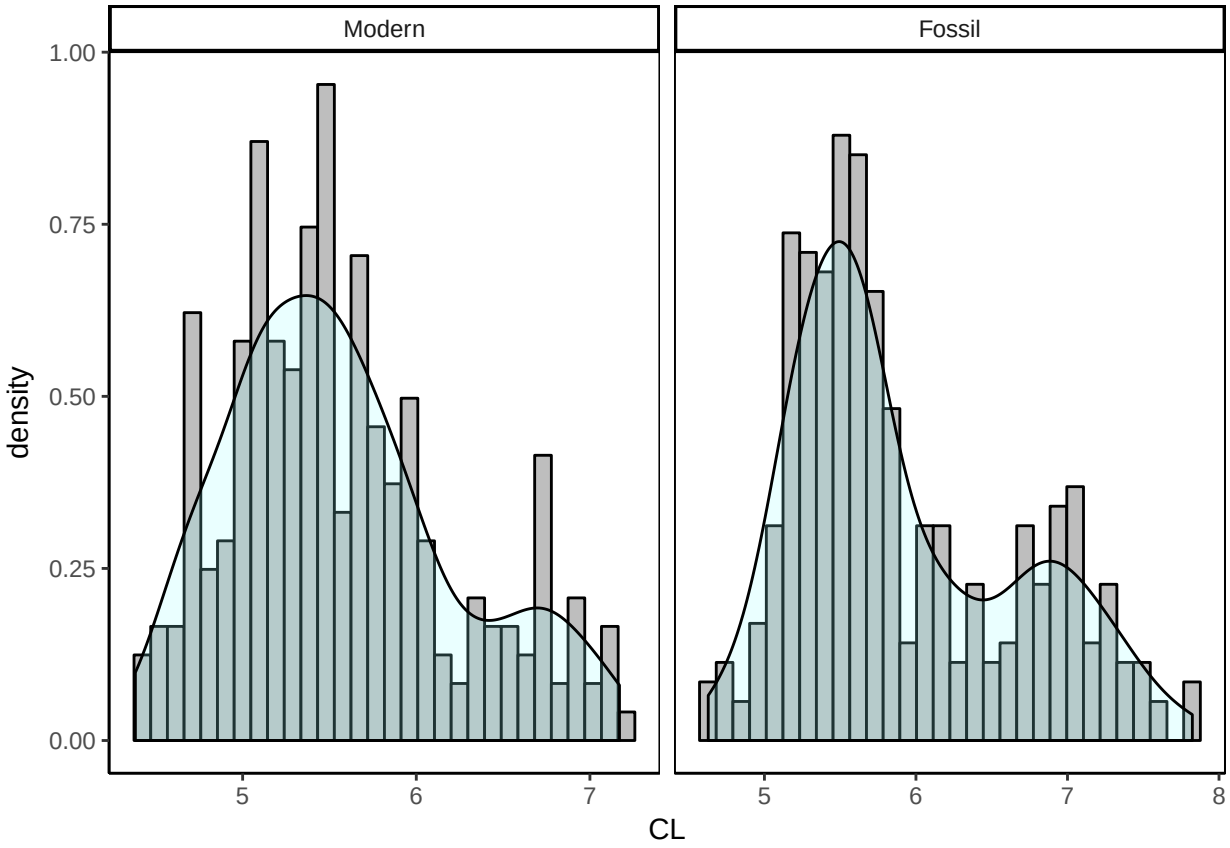


Figure 7: Distribution of body size data modern vs. fossil, logtransformed.

modern vs. fossil, continental vs. insular

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

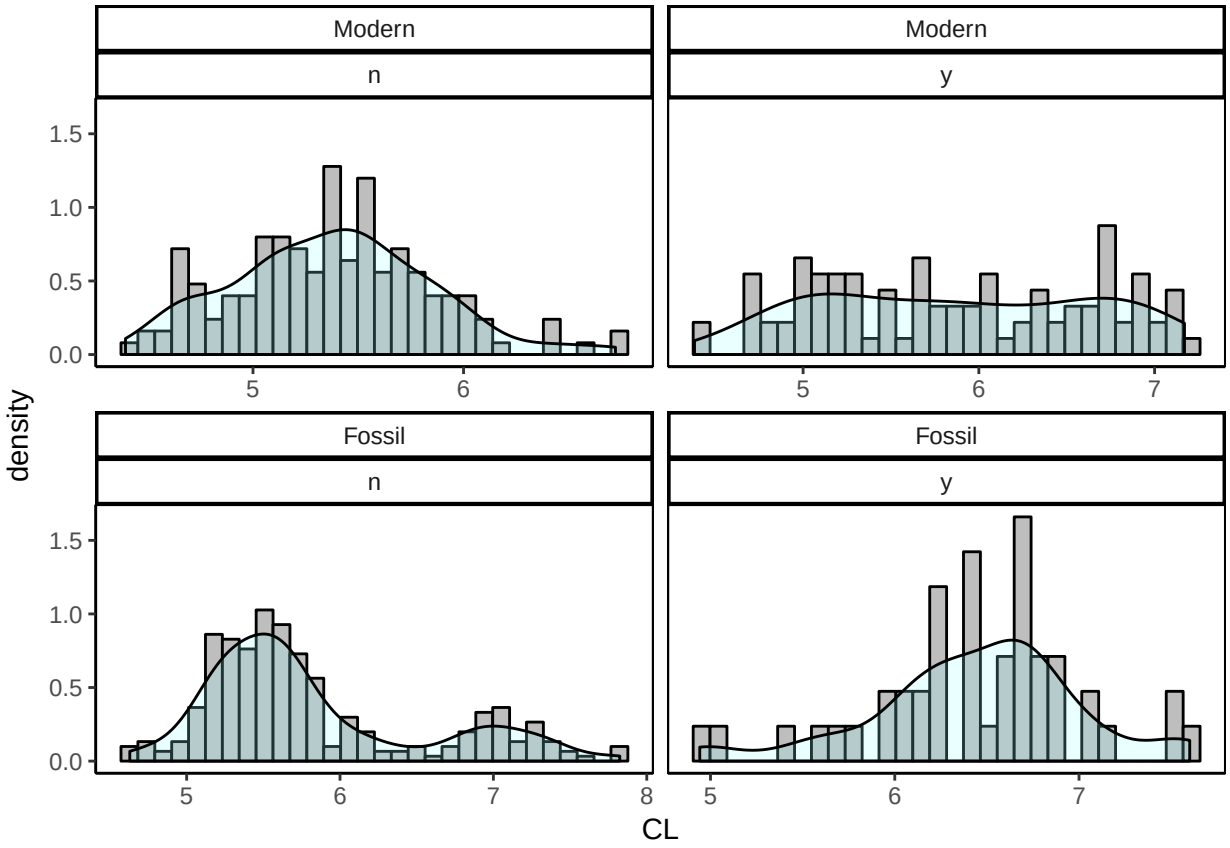


Figure 8: Distribution of body size data modern vs. fossil, continental vs. insular logtransformed.

continental vs. insular

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

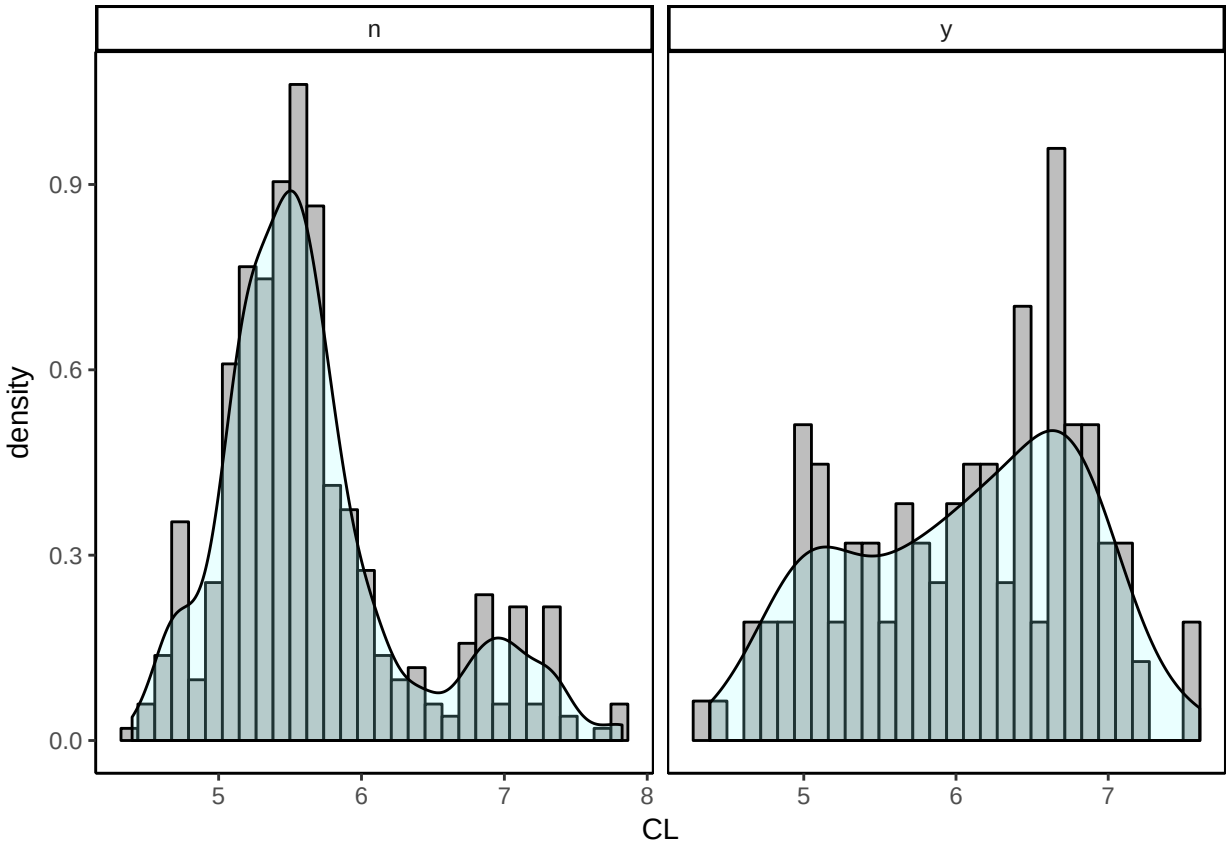


Figure 9: Distribution of body site data of continental (n) and insular(y) species, logtransformed.

continents

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

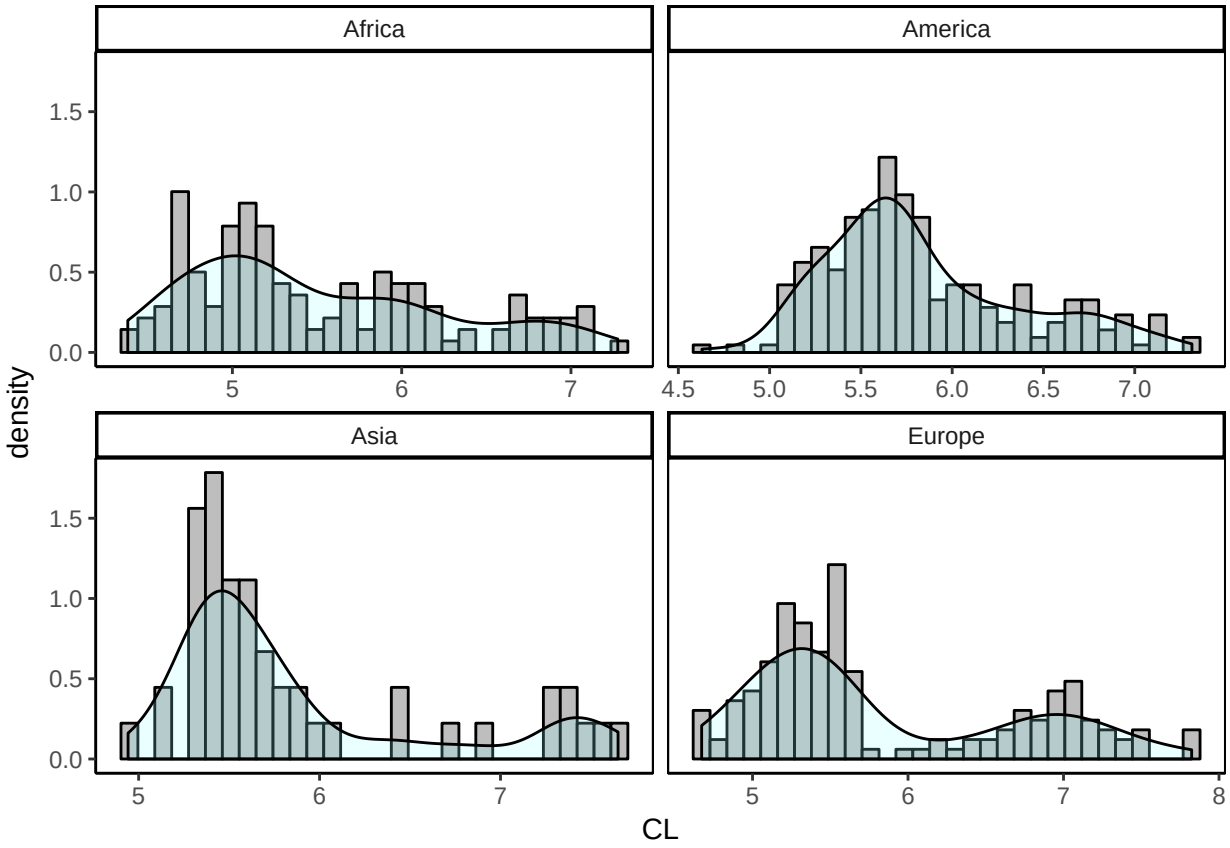


Figure 10: Distribution of body site data per continent, logtransformed.

General statistics

Table 3: General statistics of body size data: all, per time bin, insular and continental, per continent (all referring to CL: min, max, variance, mean, logmean, median, logmedian, skewness, logskewness, kurosis, logkurtosis

nCL	min	max	var	mean	logm	med	logmed	skew	logsk	kurt	logku	Variable
571	80.00	2500	153024.63	424.8	2.5	270.0	2.4	2.23	0.70	8.71	2.79	all
251	80.00	1300	67716.64	328.9	2.4	242.0	2.4	1.85	0.60	5.91	2.73	Modern
47	102.44	1250	68679.40	441.9	2.6	334.7	2.5	1.26	0.24	3.85	2.66	Upper Pleistocene
48	132.00	1500	63574.87	360.3	2.5	288.8	2.5	2.95	1.50	11.95	5.69	Middle Pleistocene
47	107.80	2000	165103.07	460.3	2.5	259.5	2.4	1.90	0.78	6.44	2.55	Lower Pleistocene
24	118.90	1860	195107.42	333.4	2.4	186.2	2.3	2.60	2.07	8.39	5.95	Gelasian(LowPlei2)
20	165.00	1600	269797.71	636.6	2.7	440.5	2.6	0.96	0.29	2.38	1.78	Upper Pliocene
18	185.00	2500	610493.44	1068.4	2.9	900.0	3.0	0.80	-0.35	2.52	2.09	Lower Pliocene 1
6	176.00	880	108570.00	608.8	2.7	785.5	2.9	-0.67	-0.70	1.51	1.52	Lower Pliocene 2
10	140.00	2100	602611.21	948.9	2.8	916.0	2.9	0.26	-0.22	1.49	1.29	Upper Miocene 1
30	112.00	1540	183698.15	472.8	2.5	250.0	2.4	1.57	0.90	3.99	2.72	Upper Miocene 2
10	107.00	1170	161993.40	442.6	2.5	236.5	2.4	1.14	0.51	2.68	1.95	Upper Miocene 3
22	111.00	1353	88365.91	303.2	2.4	209.5	2.3	2.73	1.83	9.30	5.83	Middle Miocene 1
14	270.00	1600	248524.79	835.4	2.8	1000.0	3.0	0.05	-0.23	1.45	1.25	Middle Miocene 2
18	160.00	1100	103008.71	444.2	2.5	302.0	2.5	0.99	0.44	2.53	1.77	Lower Miocene 1
6	230.00	620	20626.67	370.7	2.5	335.0	2.5	0.85	0.45	2.50	2.02	Lower Miocene 2
251	80.00	1300	67716.64	328.9	2.4	242.0	2.4	1.85	0.60	5.91	2.73	Modern
320	102.44	2500	207448.16	500.0	2.6	287.8	2.5	1.92	0.72	6.70	2.50	Fossil
430	81.00	2500	147179.14	381.9	2.5	249.8	2.4	2.76	1.10	11.48	3.89	continental
141	80.00	2000	149135.58	555.6	2.6	486.0	2.7	1.09	-0.25	4.39	2.03	insular
156	81.00	830	16385.92	241.9	2.3	220.5	2.3	1.97	0.29	8.59	3.02	fossil-con
95	80.00	1300	119898.26	471.7	2.6	351.0	2.5	0.82	0.02	2.44	1.75	fossil-ins
274	102.44	2500	204405.38	461.6	2.5	270.0	2.4	2.15	1.00	7.62	3.02	modern-con
46	140.00	2000	167981.36	728.9	2.8	632.0	2.8	1.41	-0.45	5.23	3.61	modern-ins
140	80.00	1446	92601.87	337.4	2.4	193.5	2.3	1.69	0.64	5.04	2.35	Africa

nCL	min	max	var	mean	logm	med	logmed	skew	logsk	kurt	logku	Variable
231	102.44	1500	72942.55	403.8	2.5	300.0	2.5	1.83	0.75	6.06	2.94	America
48	140.00	2100	290958.22	510.7	2.6	272.5	2.4	1.84	1.25	4.90	3.21	Asia
152	107.00	2500	273298.31	510.1	2.5	245.0	2.4	1.77	0.74	5.88	2.18	Europe

Boxplots

genera per time bins

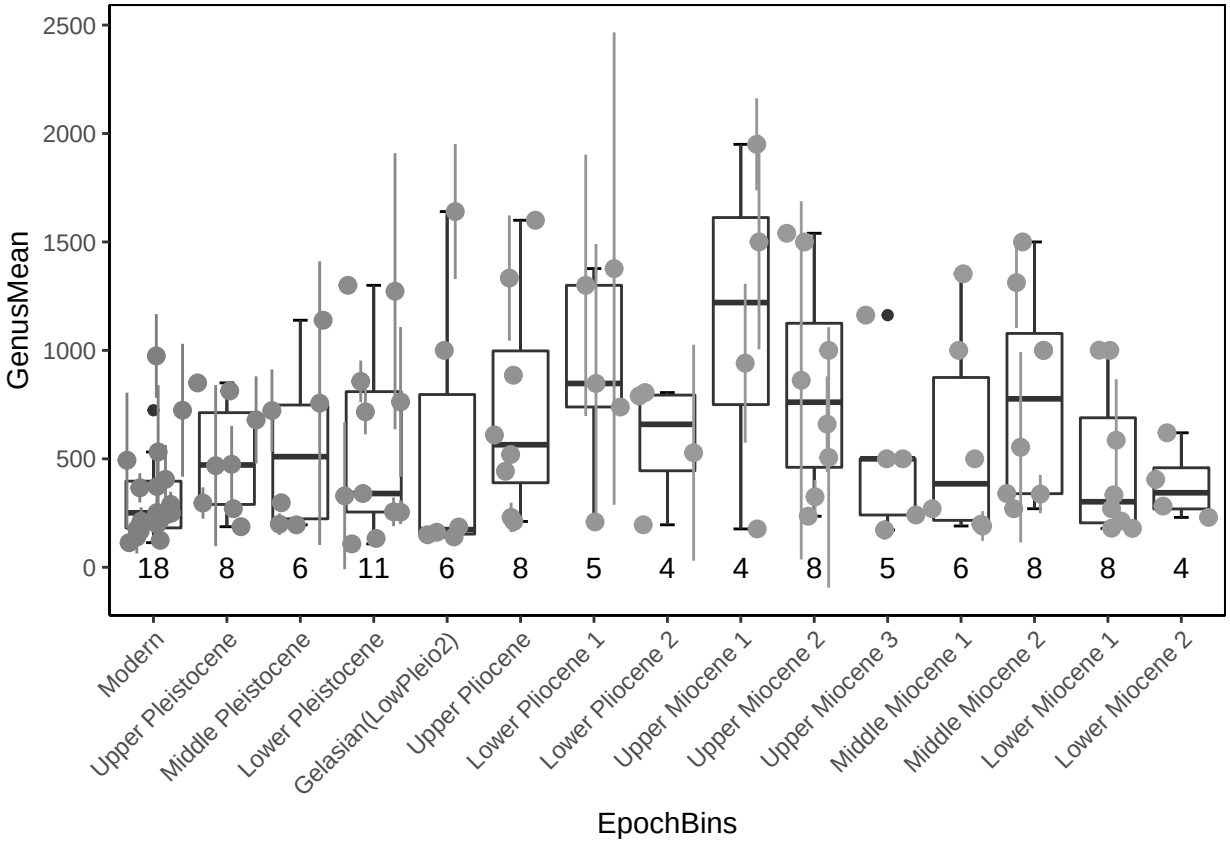


Figure 11: Boxplots of mean CL per time bin, including mean and sd CL for each genus (as pointrange).

continental vs. insular per time bin

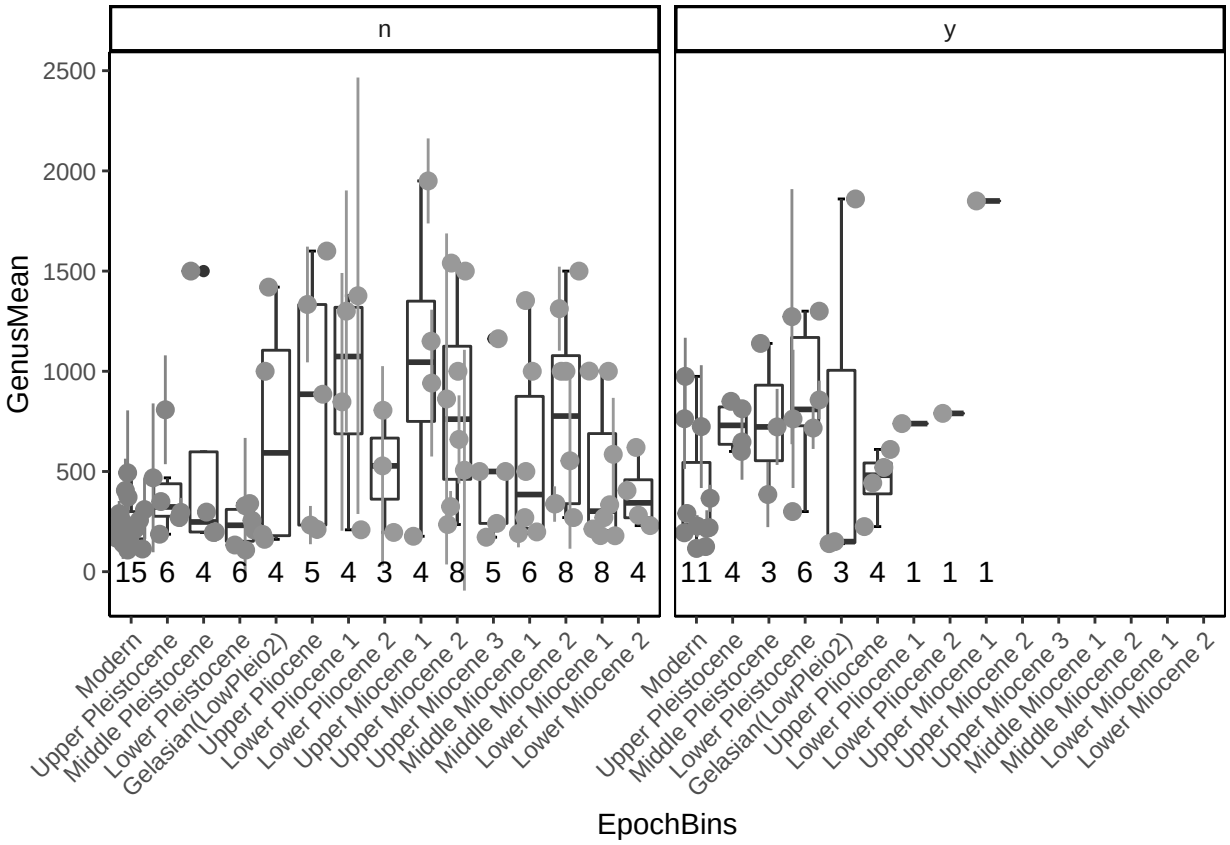


Figure 12: Boxplots of each genus per time bin, continental vs. insular species.

fossil vs. modern

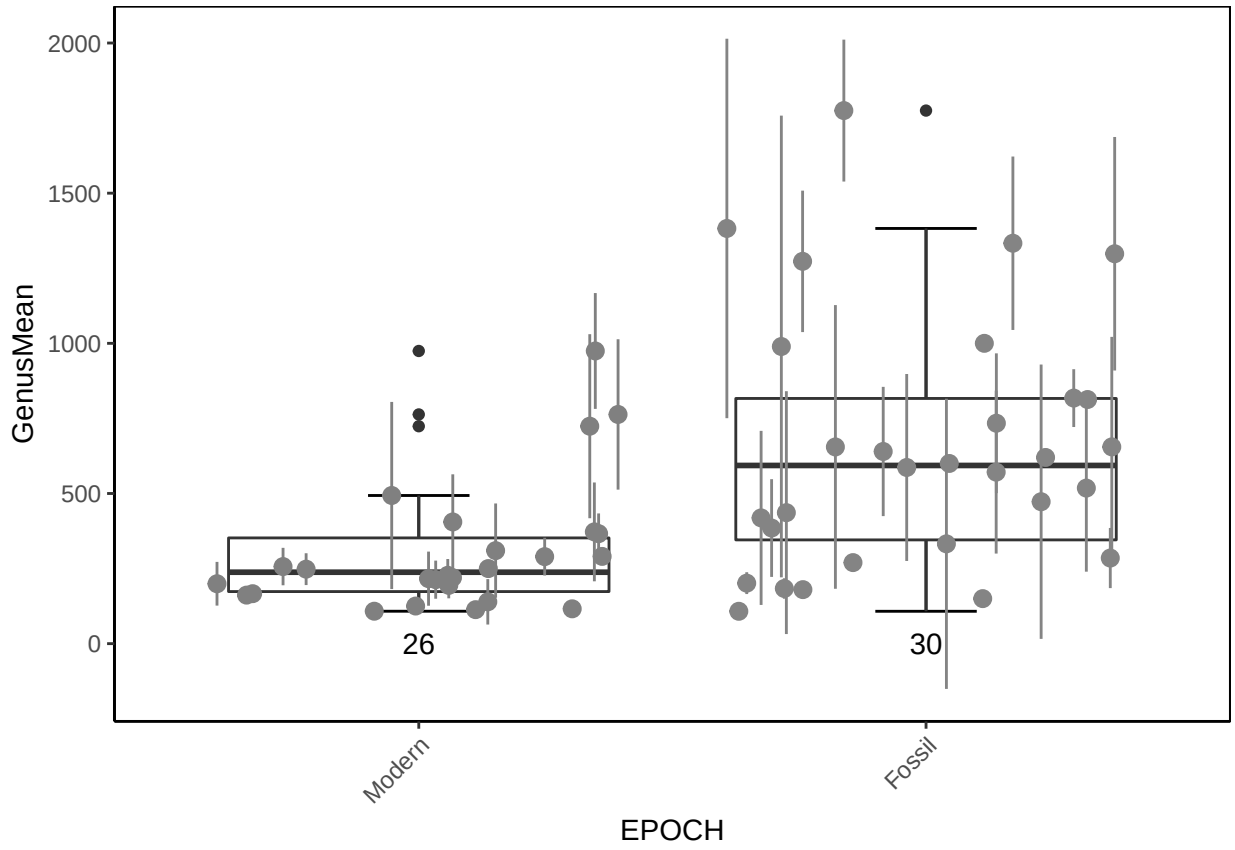
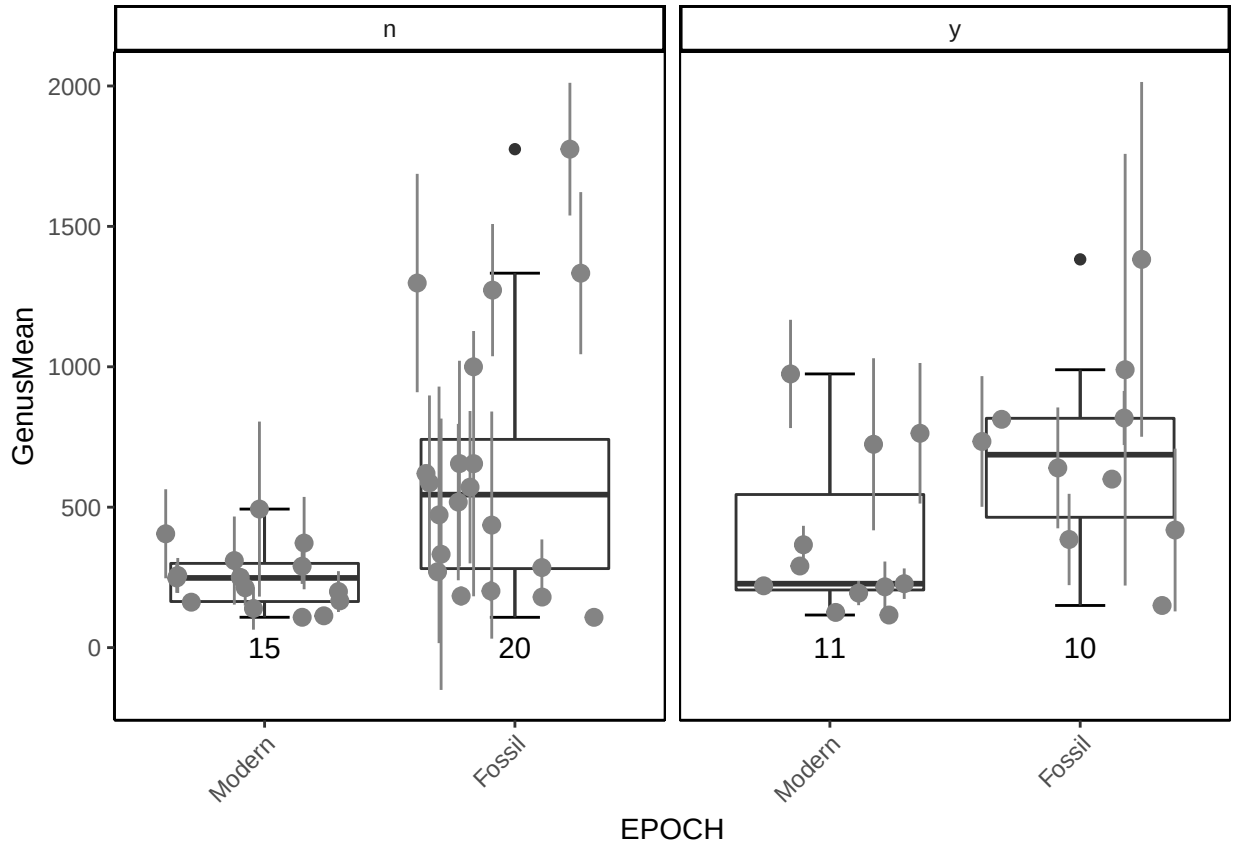


Figure 13: Boxplots fossil vs. modern.

Wilcoxon Rank Sum Test (unpaired data):

modern < fossil ($P = 1.6327968 \times 10^{-8}$)

fossil vs. modern, continental vs. insular



Wilcoxon Rank Sum Test (unpaired data):

modern continental < fossil continental ($P = 1.1915312 \times 10^{-9}$)

modern insular < fossil insular ($P = 6.2264268 \times 10^{-5}$)

continental vs. insular

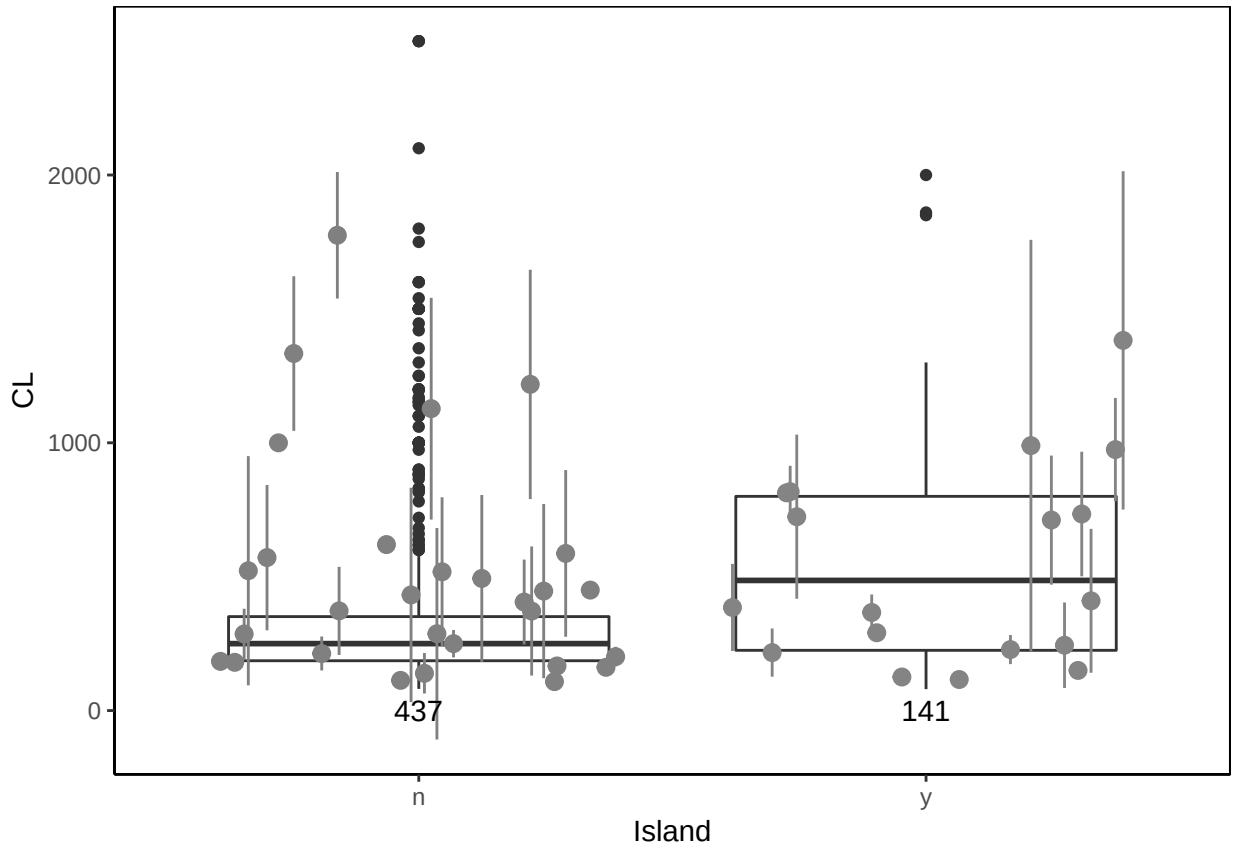


Figure 14: Boxplot continental vs. insular, genera summarised

Wilcoxon Rank Sum Test (unpaired data):

continental < insular ($P = 1.6773219 \times 10^{-8}$)

continental vs. insular per time bin

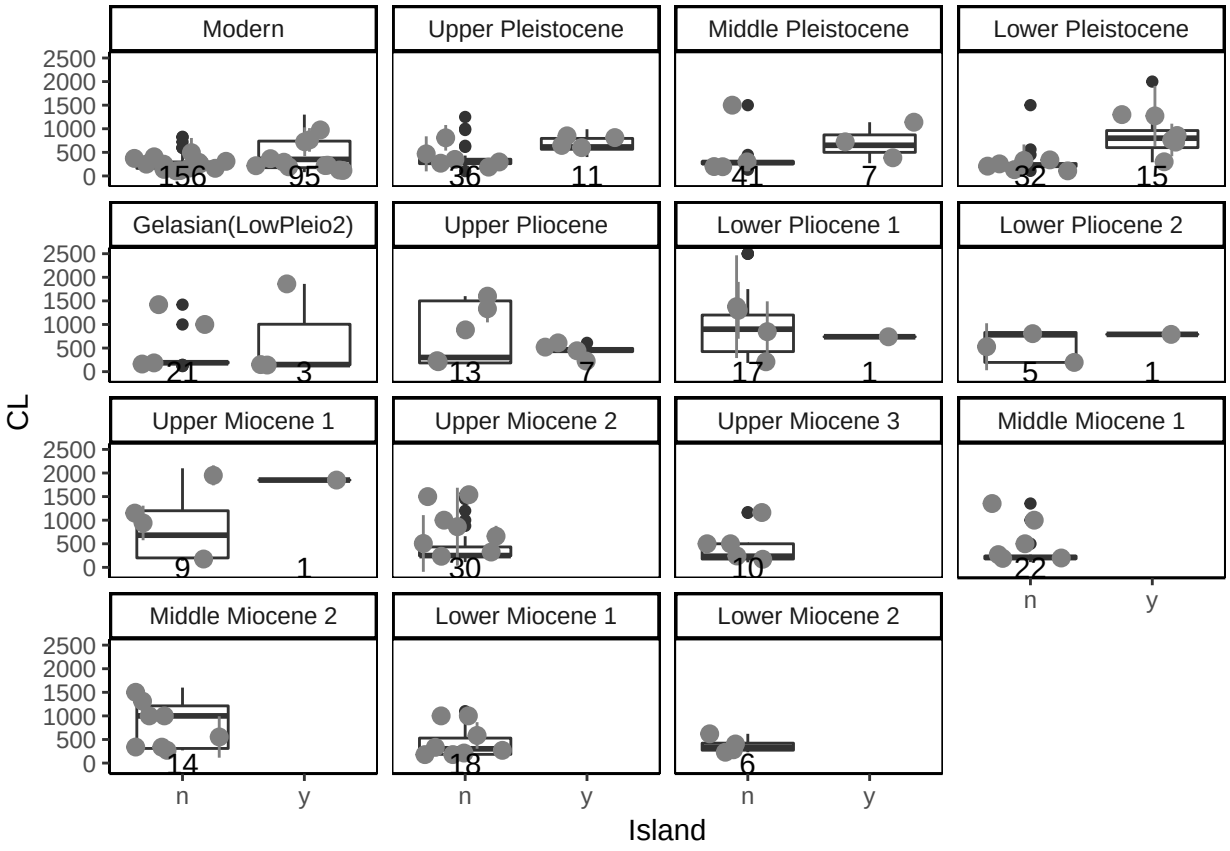


Figure 15: Boxplot continental vs. insular, genera summarised

continents

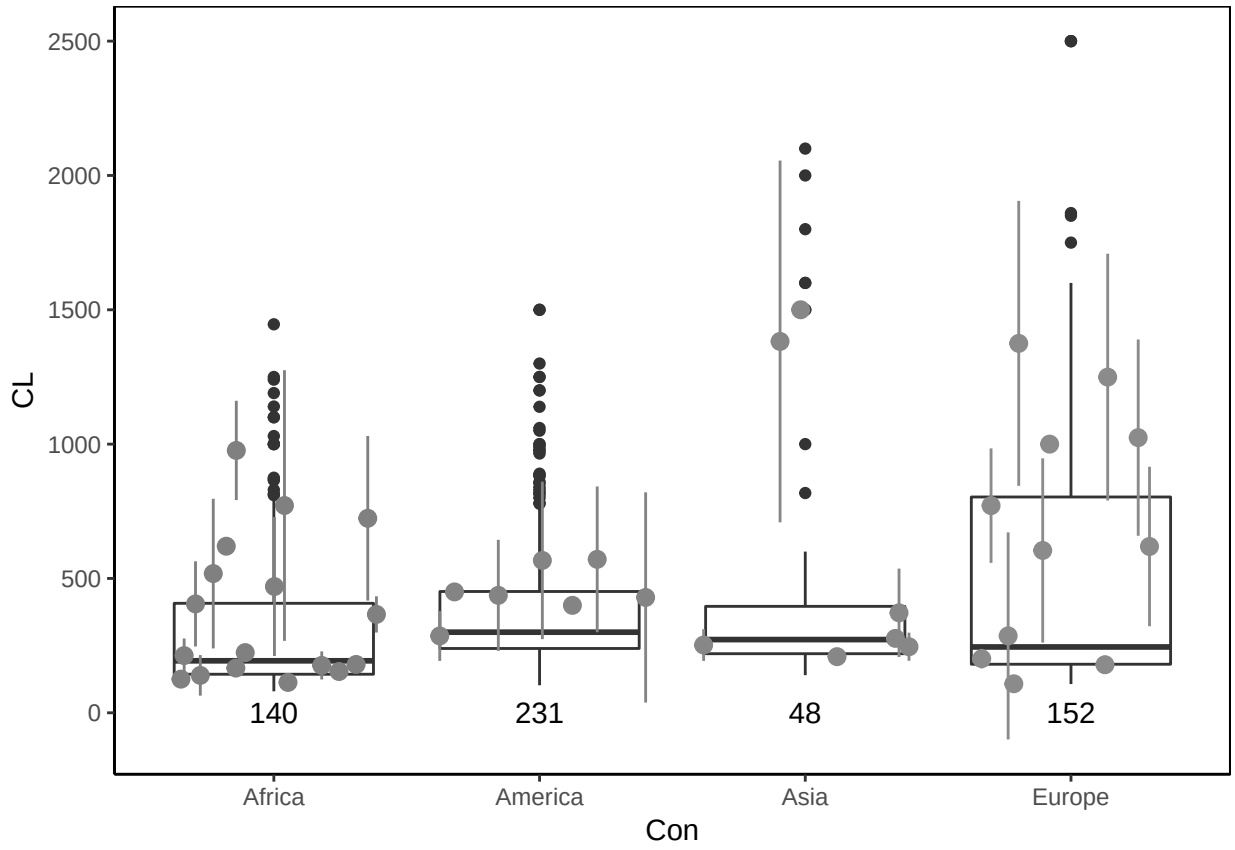


Figure 16: Boxplot: body size on different continents, genera summarised

Wilcoxon Rank Sum Test (unpaired data):

Continent means differ ($P = 1.1297236 \times 10^{-7}$) (still have to look into the details...)

continents, continental vs. insular

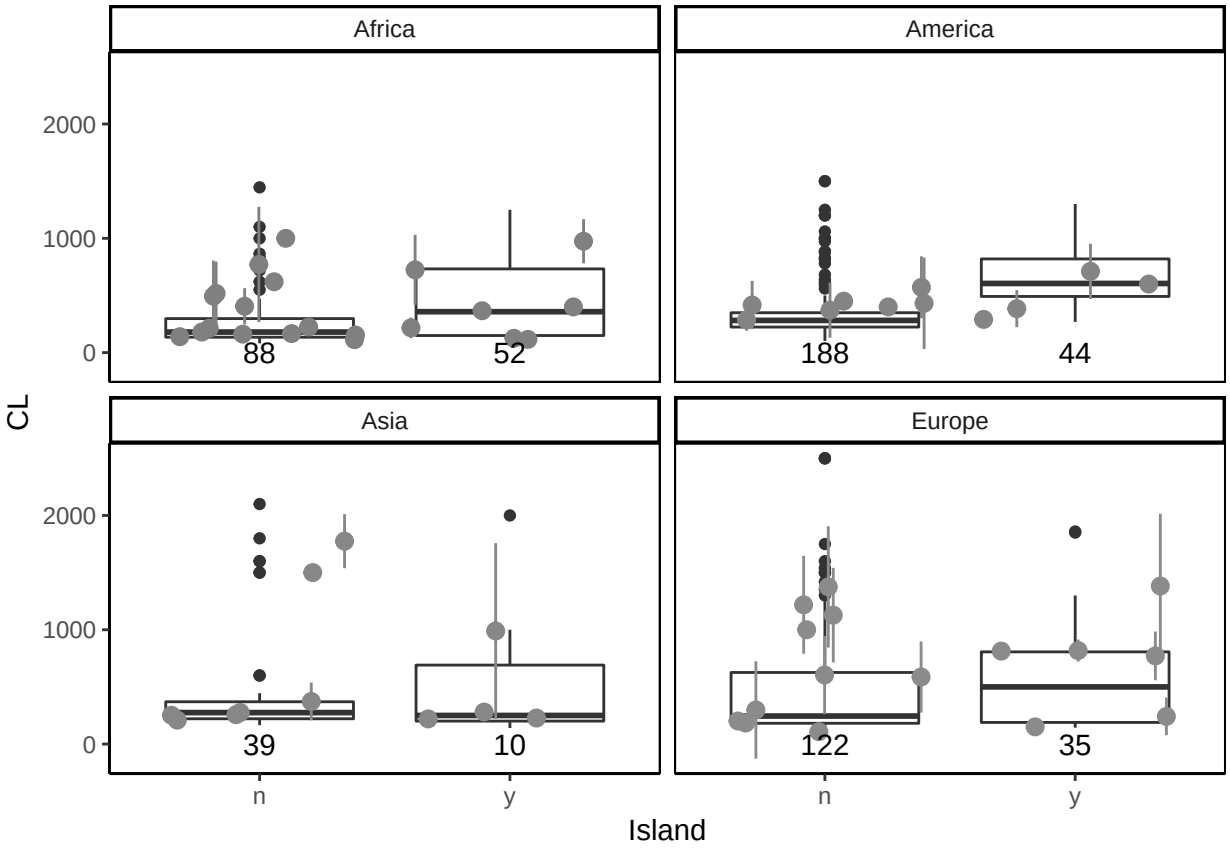


Figure 17: Boxplot: body size on different continents, genera summarised

paleoTS analysis

all (continental and insular)

genera (all)

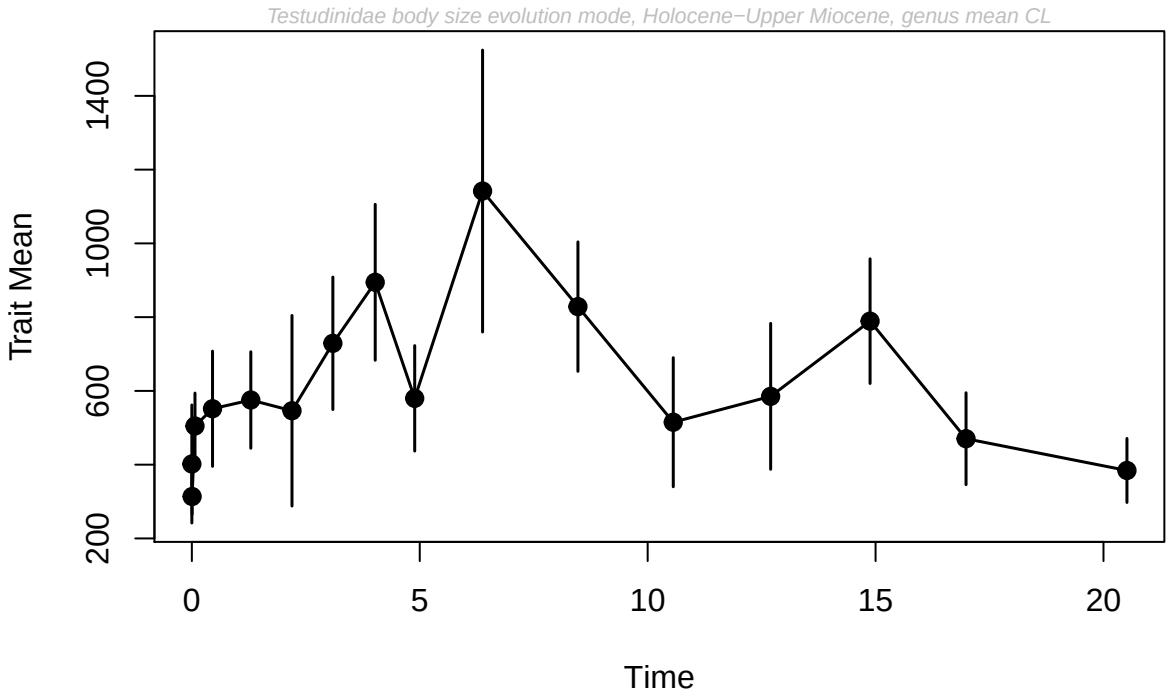


Figure 18: paleoTS plot with genus mean, including island species

Table 4: Model-fitting results for testudinidae, genera, including island species

	logL	K	AICc	Akaike.wt
GRW	-102.03165	2	209.0633	0.087
URW	-102.45142	1	207.2105	0.220
Stasis	-99.96015	2	204.9203	0.692

Table 5: Model-fitting results for testudinidae (4 models), genera, including island species

	logL	K	AICc	Akaike.wt
GRW	-102.03165	2	209.0633	0.084
URW	-102.45142	1	207.2105	0.213
Stasis	-99.96015	2	204.9203	0.669
StrictStasis	-104.31155	1	210.9308	0.033

continental (excluding insular species)

genera (continental)

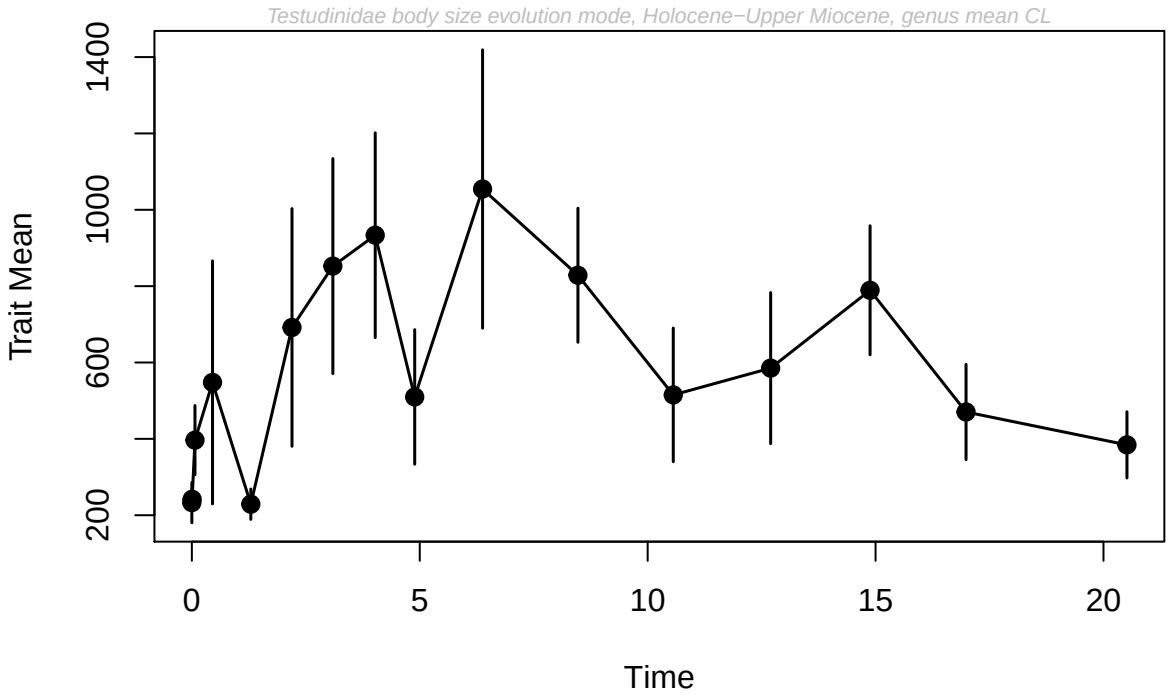


Figure 19: paleoTS plot with genus mean, excluding island species

Table 6: Model-fitting results for testudinidae, genera, excluding insular species

	logL	K	AICc	Akaike.wt
GRW	-103.6594	2	212.3187	0.250
URW	-104.2638	1	210.8353	0.526
Stasis	-103.7699	2	212.5398	0.224

Table 7: Model-fitting results for testudinidae, genera, excluding insular species

	logL	K	AICc	Akaike.wt
GRW	-103.6594	2	212.3187	0.250
URW	-104.2638	1	210.8353	0.526
Stasis	-103.7699	2	212.5398	0.224
StrictStasis	-113.9010	1	230.1096	0.000

insular (excluding continental)

genera (insular)

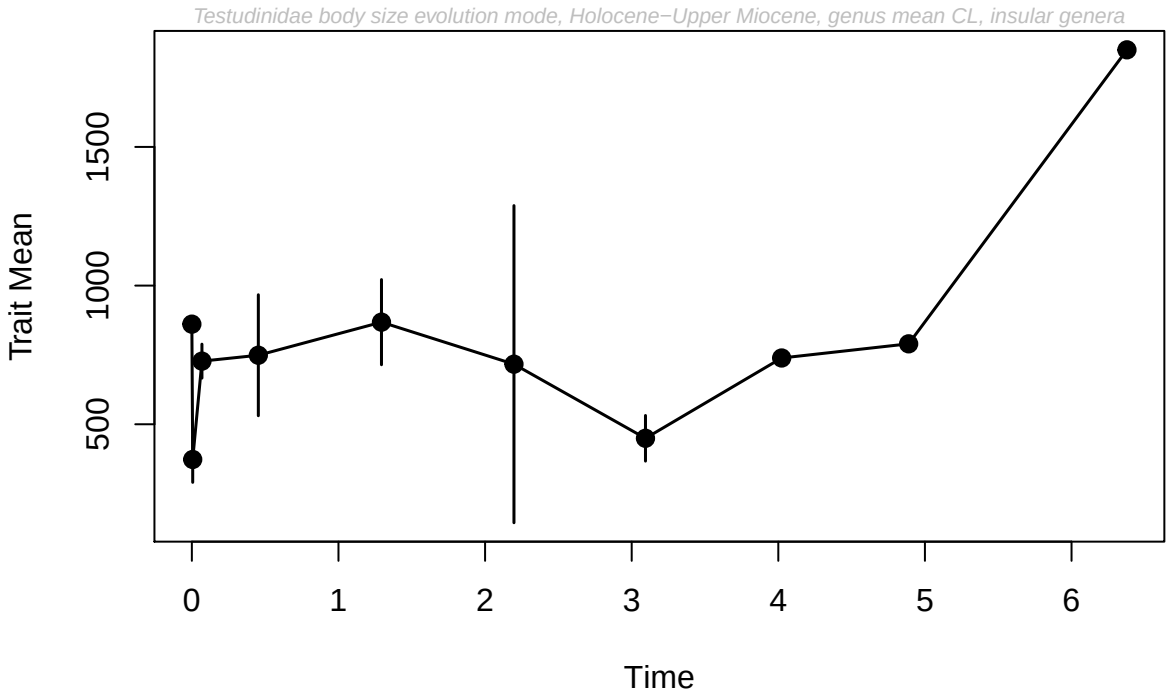


Figure 20: paleoTS plot with genus mean, only insular species

Table 8: Model-fitting results for testudinidae, genera, only insular species

	logL	K	AICc	Akaike.wt
GRW	-76.50692	2	159.0138	0
URW	-83.06382	1	168.6991	0
Stasis	-67.38663	2	140.7733	1

Equal time bins

genera (equal bins)

Table 9: paleoTS object, equal time bins, genera)

tt	mm	vv	nn
0.00025	335.6380	49292.698	17
0.50025	557.6242	95029.158	12
1.50000	558.2001	194613.806	11
2.50000	627.7867	235547.641	5
3.50000	758.8929	285072.539	7
4.50000	961.8833	621030.522	6
5.50000	1020.0000	797671.000	3
6.50000	850.0000	845000.000	2
7.50000	174.2500	435.125	2
8.50000	770.9667	229304.487	6
9.50000	1350.0000	45000.000	2
10.50000	527.1000	143534.355	5
11.50000	328.5000	58824.500	2
12.50000	602.1210	291476.249	5
13.50000	904.3333	420956.333	3
14.50000	651.9800	224901.227	5
15.50000	553.3333	0.000	1
16.50000	532.6600	183446.278	5
17.50000	366.5238	41915.395	3
18.50000	405.0000	0.000	1
19.50000	377.3333	44841.333	3
23.50000	406.2500	0.000	1
25.50000	450.0000	0.000	1
32.50000	275.0000	0.000	1
33.50000	400.0000	0.000	1
49.50000	617.5000	0.000	1

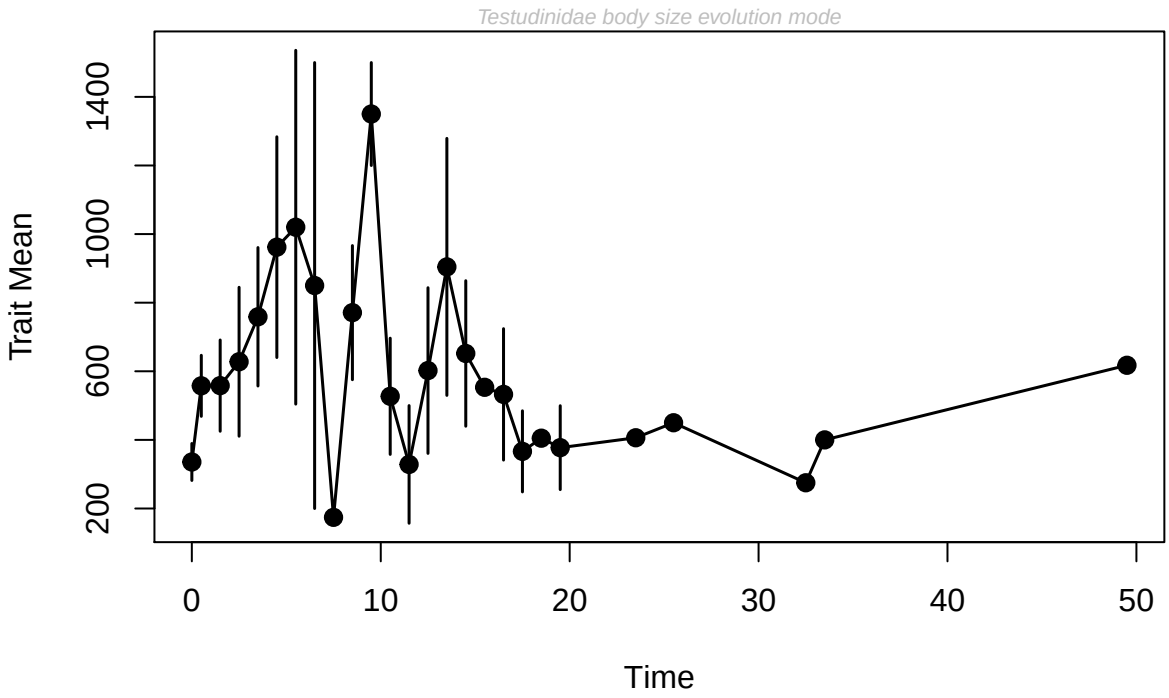


Figure 21: Equal bins, genera

Table 10: Model-fitting results for testudinidae, equal time bins, genera

	logL	K	AICc	Akaike.wt
GRW	-179.4657	2	363.4769	0.006
URW	-180.1926	1	362.5590	0.009
Stasis	-174.3472	2	353.2398	0.985

larger equal bins

genera (larger equal bins)

Table 11: PaleoTS object, larger equal bins, genera

tt	mm	vv	nn
0.5	406.1103	74156.024	21
1.5	558.2001	194613.806	11
2.5	627.7867	235547.641	5
3.5	758.8929	285072.539	7
4.5	961.8833	621030.522	6
5.5	1020.0000	797671.000	3
6.5	850.0000	845000.000	2
7.5	174.2500	435.125	2
8.5	770.9667	229304.487	6
9.5	1350.0000	45000.000	2
10.5	527.1000	143534.355	5
11.5	328.5000	58824.500	2
12.5	602.1210	291476.249	5
13.5	904.3333	420956.333	3
14.5	651.9800	224901.227	5
15.5	553.3333	0.000	1
16.5	532.6600	183446.278	5
17.5	366.5238	41915.395	3
18.5	405.0000	0.000	1
19.5	377.3333	44841.333	3
23.5	406.2500	0.000	1
25.5	450.0000	0.000	1
32.5	275.0000	0.000	1
33.5	400.0000	0.000	1
49.5	617.5000	0.000	1

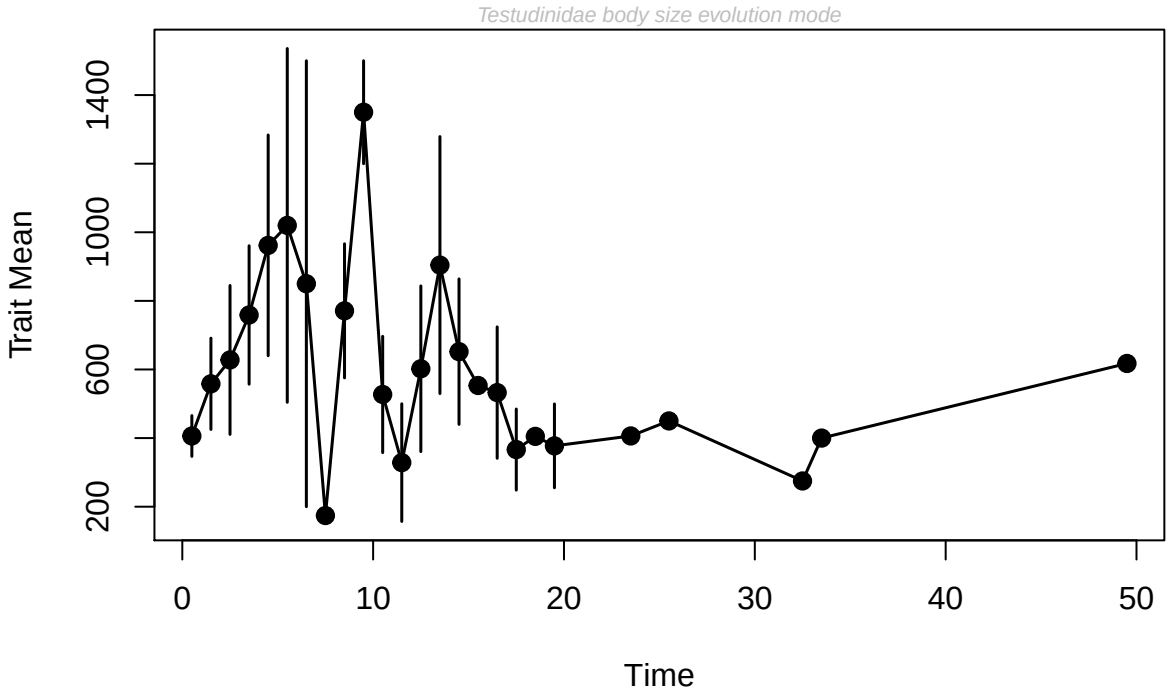


Figure 22: Larger equal bins, genera

Table 12: Model-fitting results for testudinidae, larger equal time bins, genera

	logL	K	AICc	Akaike.wt
GRW	-172.4164	2	349.4042	0.012
URW	-172.9589	1	348.0997	0.023
Stasis	-168.0413	2	340.6540	0.965

per continent

Europe, smaller original bins (see Table 2), genera

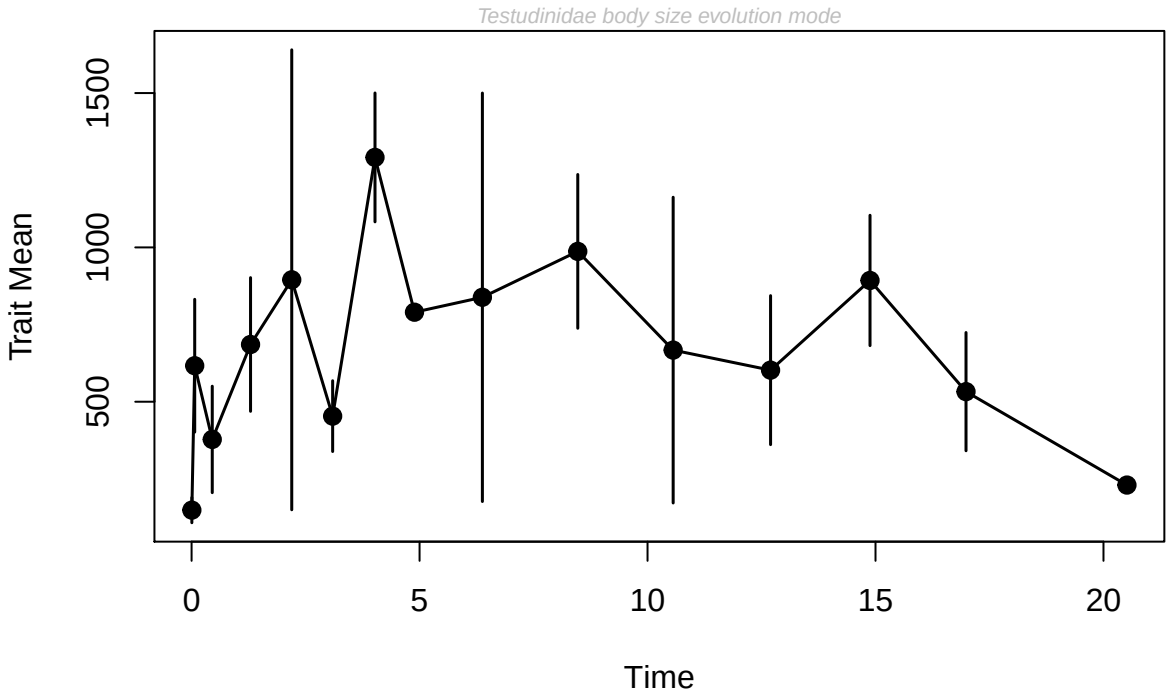


Figure 23: Smaller original bins, genera, Europe

Table 13: Model-fitting results for testudinidae, no bins, genera

	logL	K	AICc	Akaike.wt
GRW	-110.4329	2	225.9567	0.004
URW	-111.1716	1	224.6765	0.007
Stasis	-104.8023	2	214.6954	0.990

Eurasia, smaller original bins (See Table 2), genera

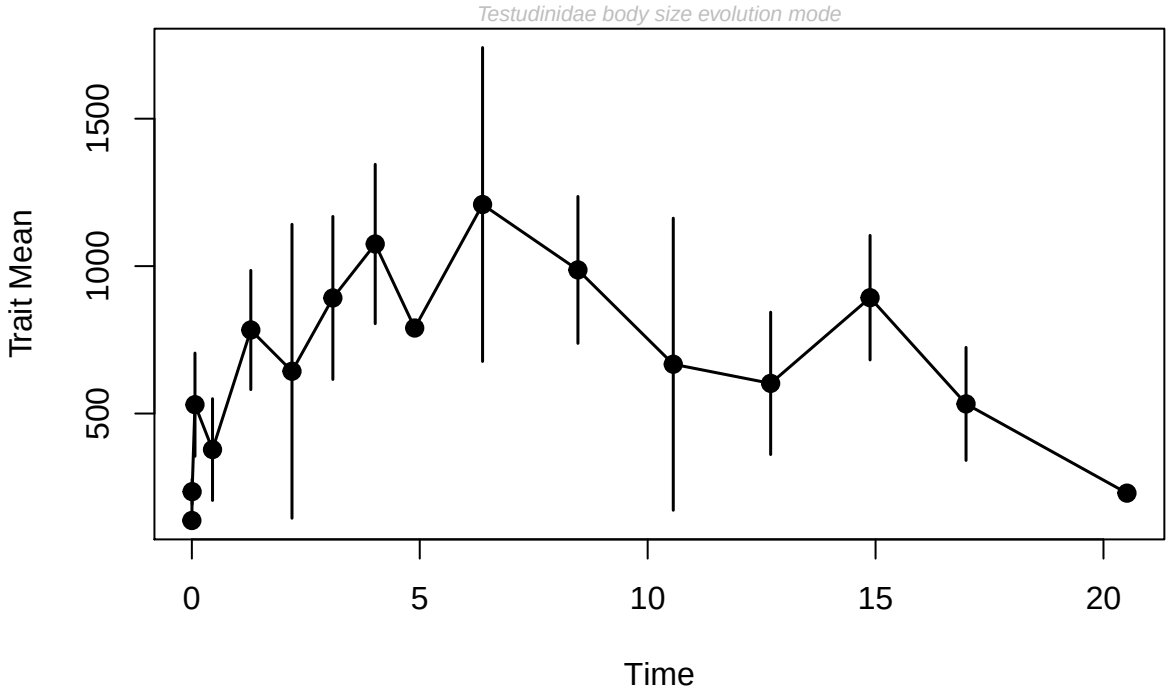


Figure 24: Smaller original bins, genera, Eurasia

Table 14: Model-fitting results for testudinidae, no bins, genera

	logL	K	AICc	Akaike.wt
GRW	-108.1541	2	221.3083	0.198
URW	-109.0897	1	220.4870	0.298
Stasis	-107.2170	2	219.4341	0.504