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	47	16	8
(0.126,0.781]	Middle Pleistocene	0.45350	48	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	52	23	9
(11.6,16]	Middle Miocene	13.78900	38	17	11
(16,23]	Lower Miocene	19.50000	25	13	9
(23,50]	Oligocene and Eocene	36.51500	7	5	5

Maps

fossil occurences of testudinidae

body size of testudinidae

Sampling Accumulation Curve

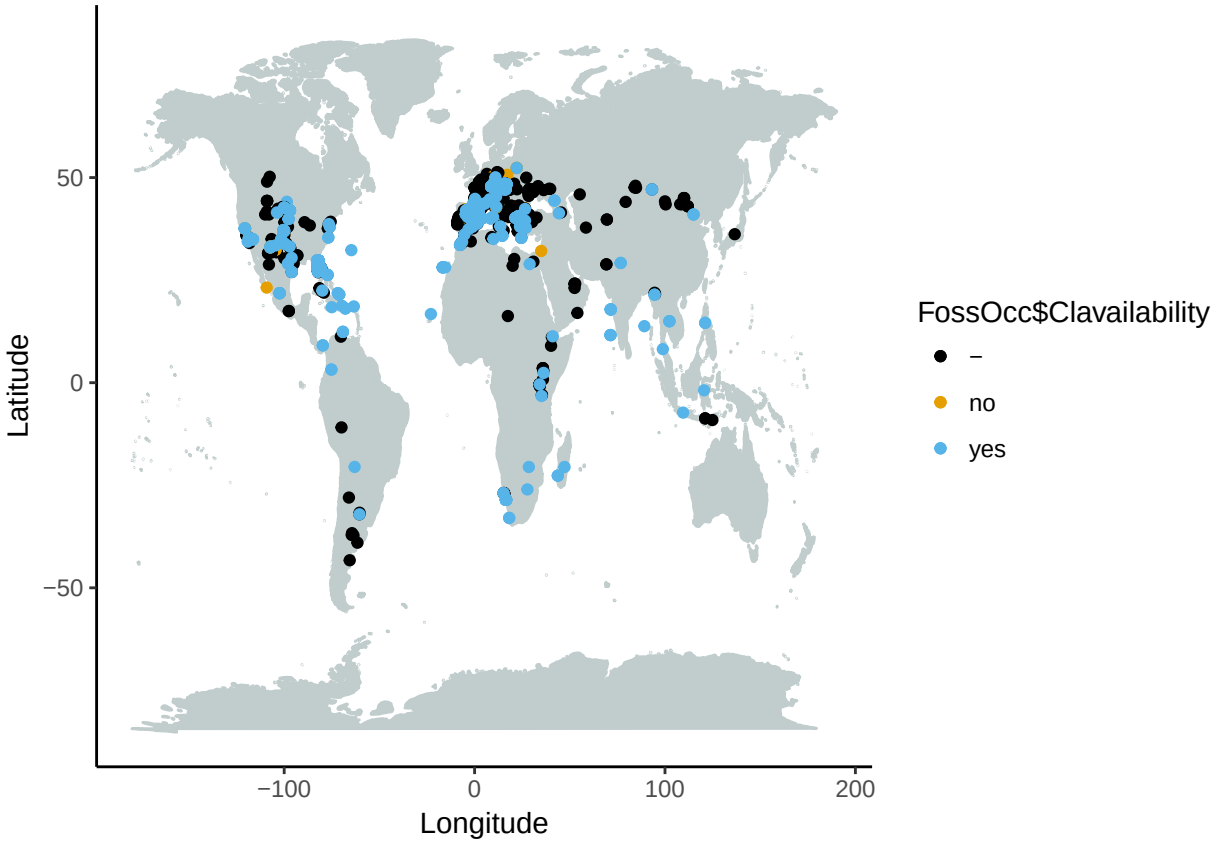

Figure 1: Map displaying all fossil occurrences of testudinids, with color indicating whether relevant literature was available (black if not) and if it was, whether body size data was available or not (yes and no, respectively).

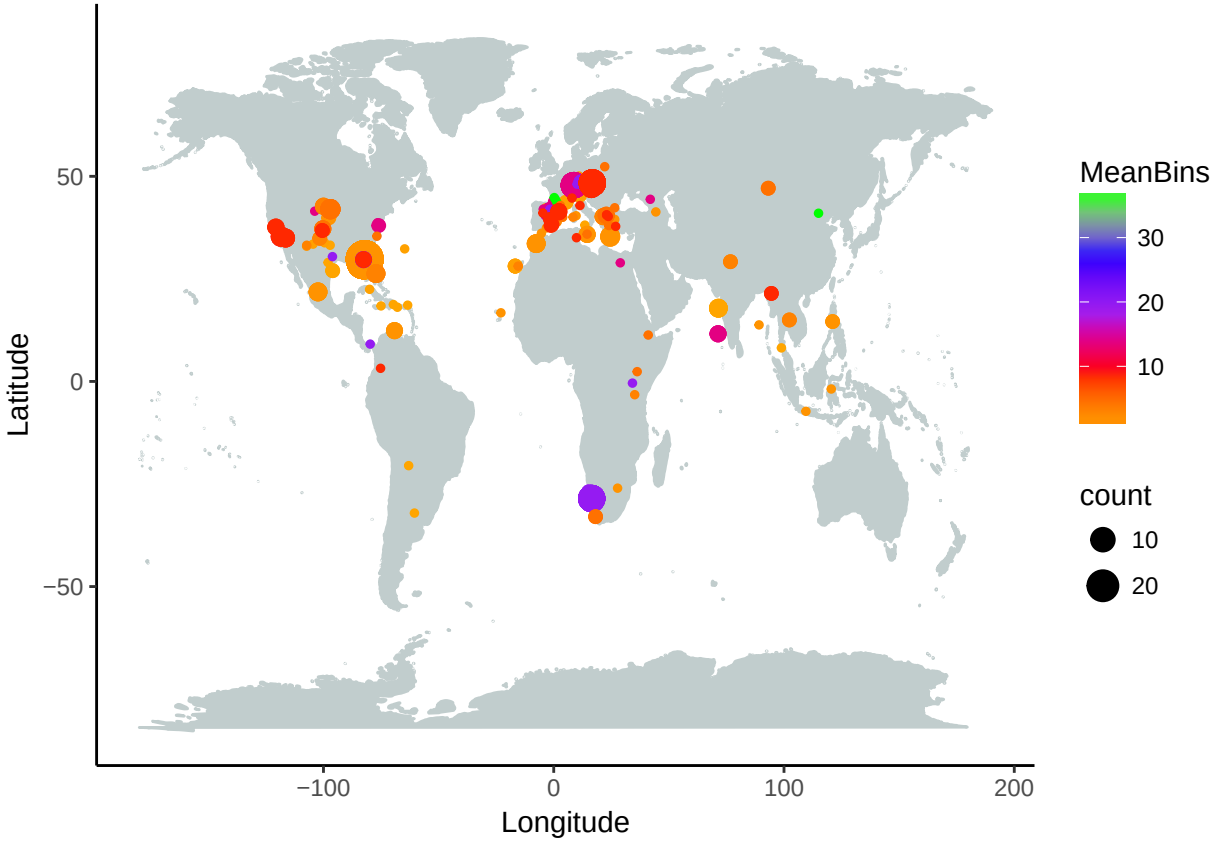

Figure 2: Map displaying all localities for which body size data for testudinids was available in the literature. Size of points denotes sample size, color denotes approximate age.

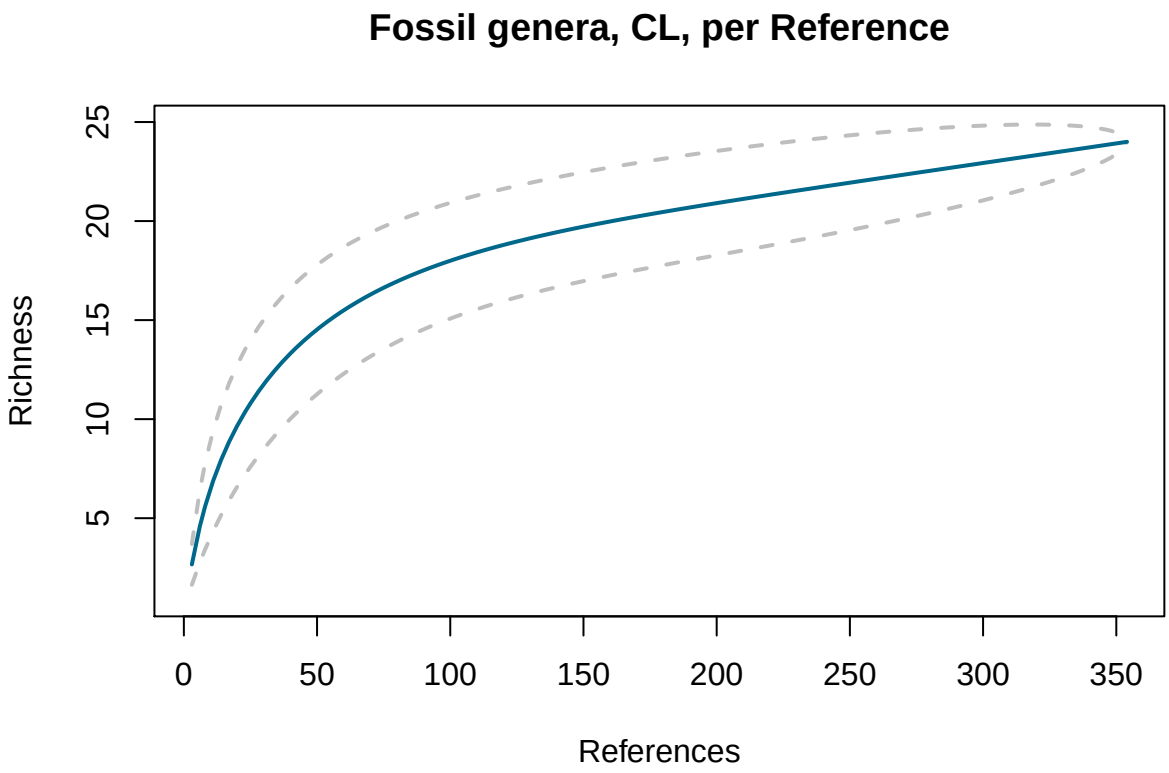

Figure 3: Sampling Accumulation Curve of fossil genera per reference

Histograms

all

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

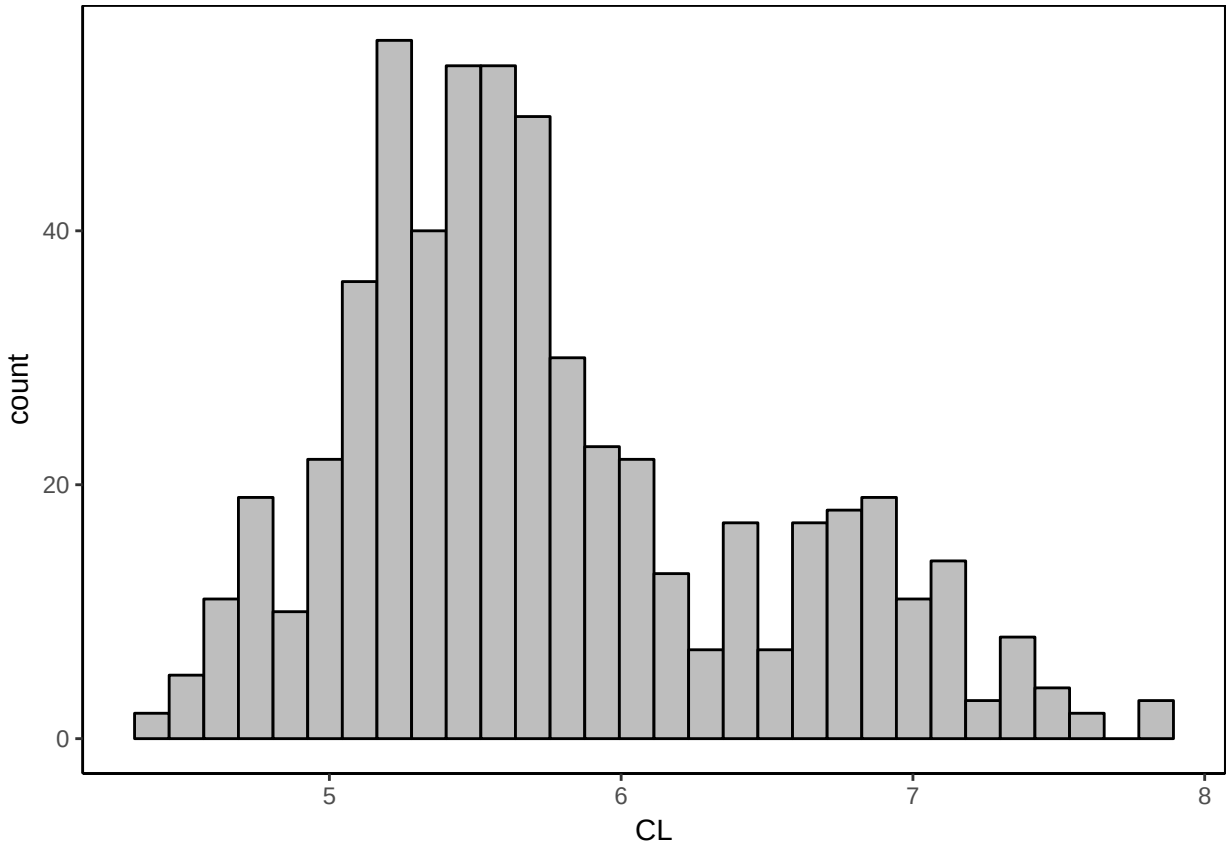

Figure 4: Distribution of body size data, logtransformed, all data.

per time bin

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

continental vs. insular

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

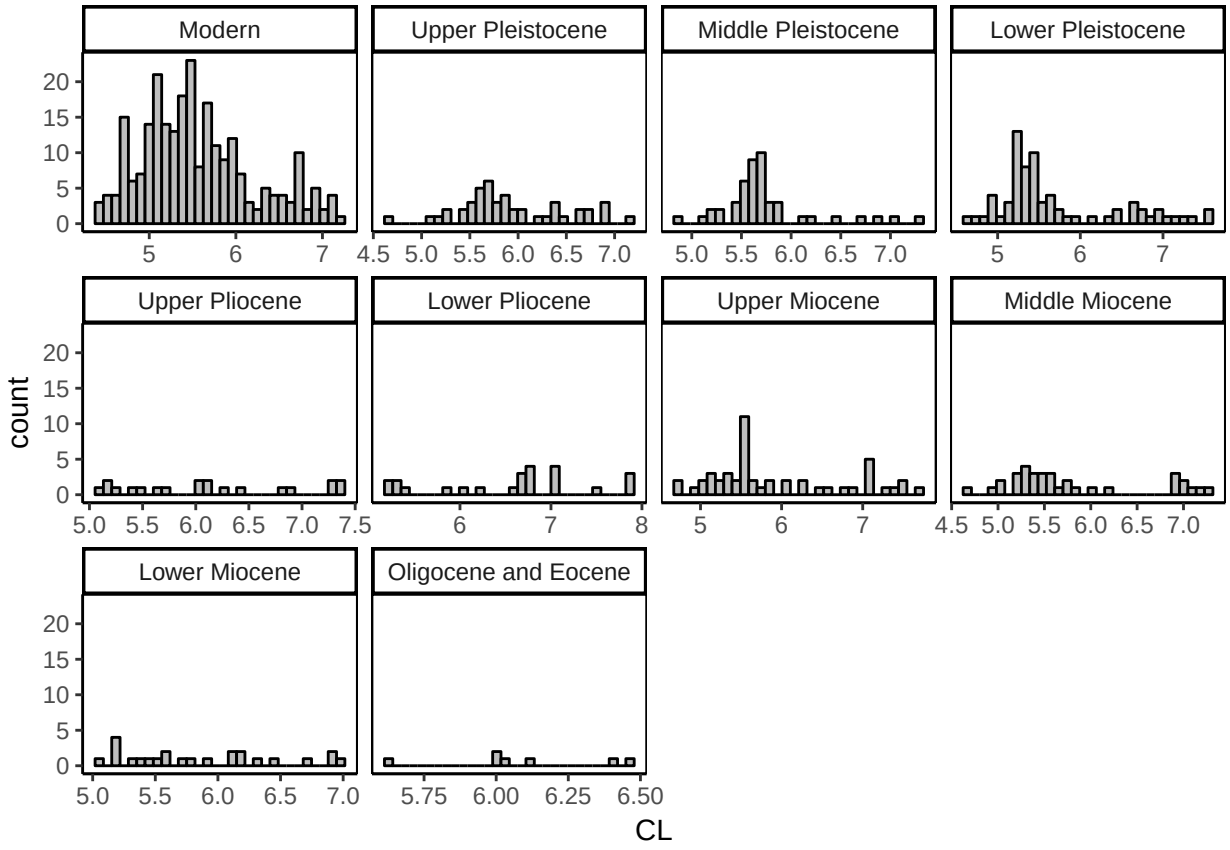

Figure 5: Distribution of body size data per time bin, logtransformed.

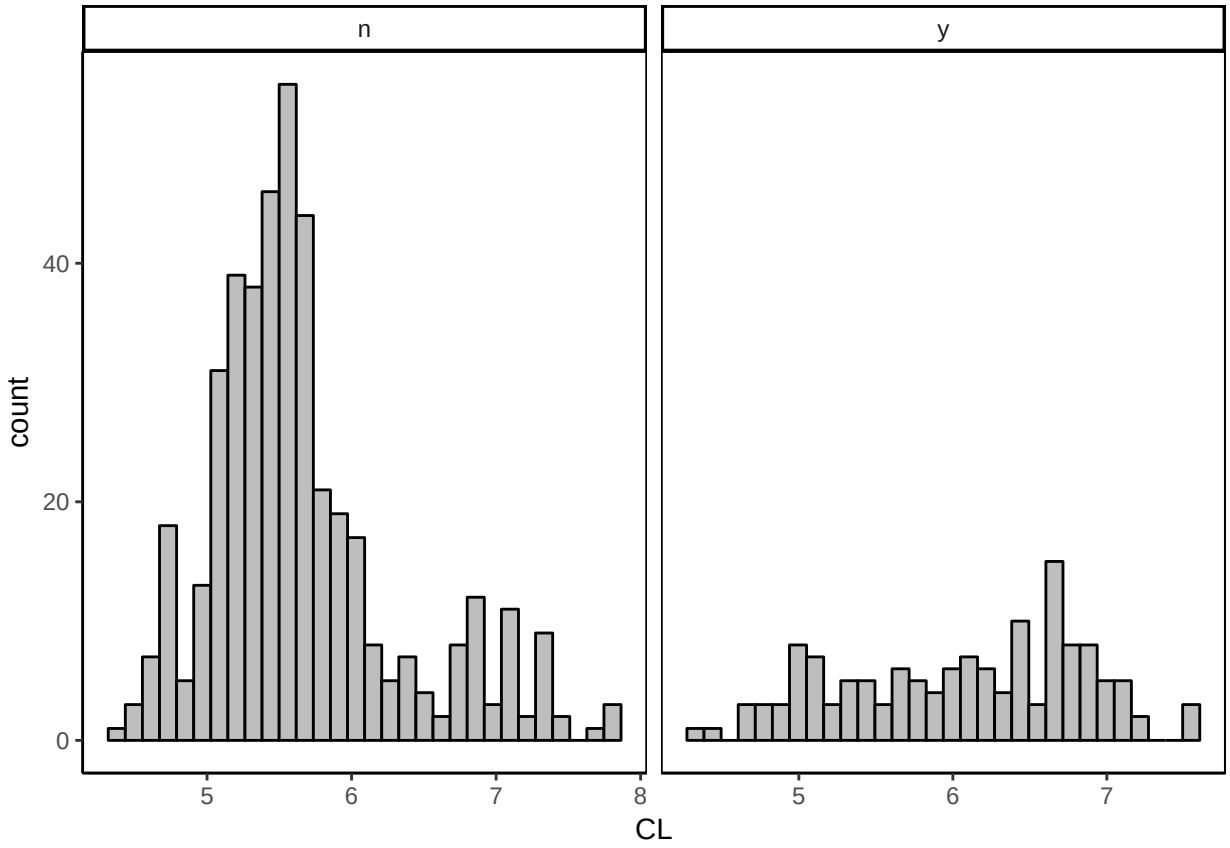

Figure 6: Distribution of body site data of continental (n) and insular(y) species, logtransformed.

continents

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

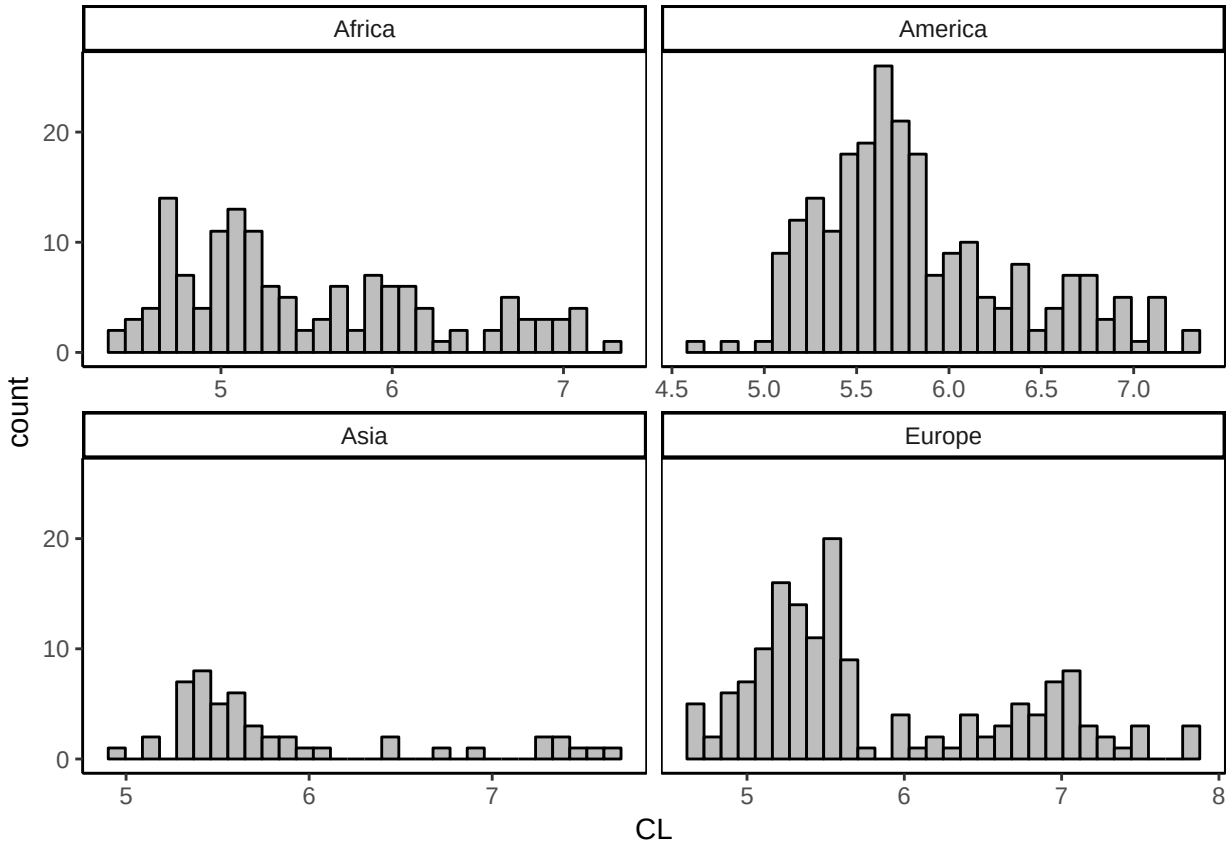

Figure 7: Distribution of body site data of continental (n) and insular(y) species, logtransformed.

Table 2: General statistics of body size data: all, per time bin, insular and continental

nCL	min	max	var	mean	logm	med	logmed	skew	logsk	kurt	logku	Variable
573	80.00	2500	146793.95	419.2	2.5	270.0	2.4	2.30	0.70	9.25	2.84	all
251	80.00	1300	67716.64	328.9	2.4	242.0	2.4	1.85	0.60	5.91	2.73	Modern
46	102.44	1250	69637.75	438.4	2.6	331.1	2.5	1.30	0.29	3.89	2.69	Upper Pleistocene
47	132.00	1500	64523.61	357.3	2.5	285.6	2.5	2.99	1.58	12.00	5.93	Middle Pleistocene
71	107.80	2000	176257.96	417.4	2.5	224.1	2.4	2.08	1.06	6.77	2.99	Lower Pleistocene
20	165.00	1600	269797.71	636.6	2.7	440.5	2.6	0.96	0.29	2.38	1.78	Upper Pliocene
24	176.00	2500	516172.48	953.5	2.8	847.5	2.9	1.08	-0.31	3.32	2.13	Lower Pliocene
49	107.00	2100	274774.35	542.8	2.6	250.0	2.4	1.46	0.66	4.00	2.17	Upper Miocene
34	111.00	1500	169511.65	454.8	2.5	255.0	2.4	1.32	0.83	3.16	2.29	Middle Miocene
24	160.00	1100	81679.97	425.8	2.5	317.0	2.5	1.20	0.48	3.25	2.06	Lower Miocene
7	275.00	635	15613.99	453.2	2.6	412.5	2.6	0.29	-0.17	2.06	2.36	Oligocene and Eocene
434	81.00	2500	137816.81	375.5	2.5	250.0	2.4	2.90	1.08	12.62	3.97	continental
139	80.00	2000	151260.27	555.7	2.6	466.0	2.7	1.08	-0.24	4.33	2.01	insular
140	80.00	1446	92601.87	337.4	2.4	193.5	2.3	1.69	0.64	5.04	2.35	Africa
230	102.44	1500	73060.64	402.7	2.5	300.0	2.5	1.85	0.77	6.10	2.97	America
49	140.00	2100	286030.39	505.9	2.6	275.0	2.4	1.87	1.28	5.03	3.29	Asia
154	107.00	2500	251479.46	490.8	2.5	245.0	2.4	1.95	0.77	6.86	2.32	Europe

Boxplots

genera per time bins

continental vs. insular per time bin

continental vs. insular

```
## Warning: Removed 9 rows containing missing values (geom_pointrange).
```

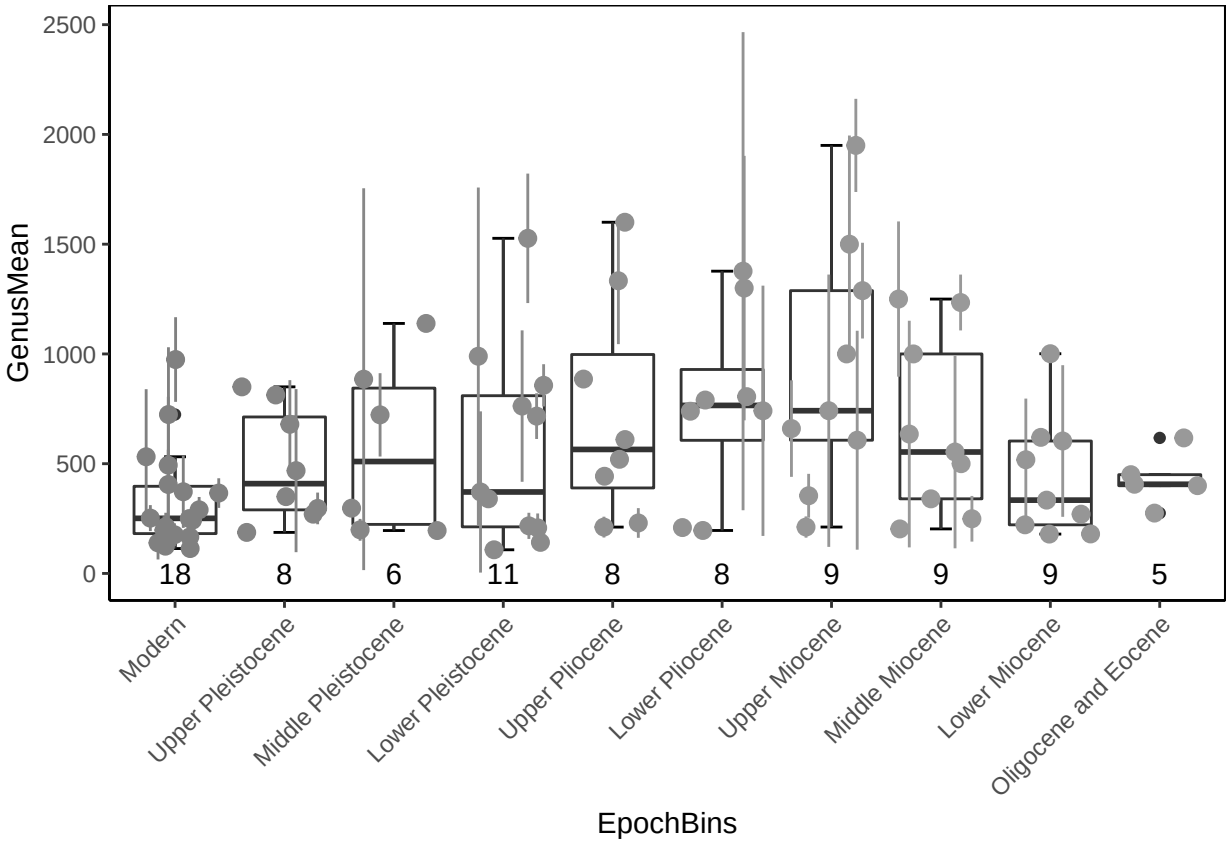

Figure 8: Boxplots of mean CL per time bin, including mean and sd CL for each genus (as pointrange).

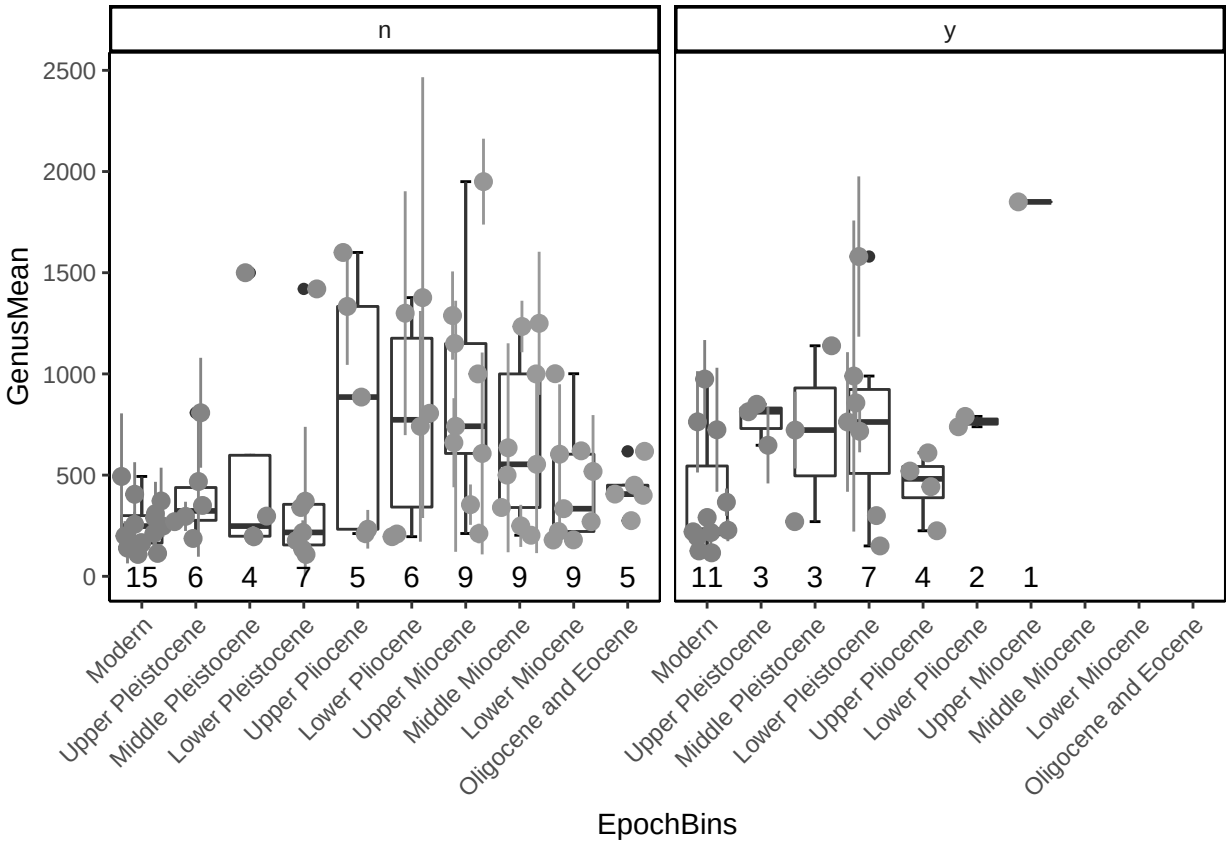

Figure 9: Boxplots of each genus per time bin, continental vs. insular species.

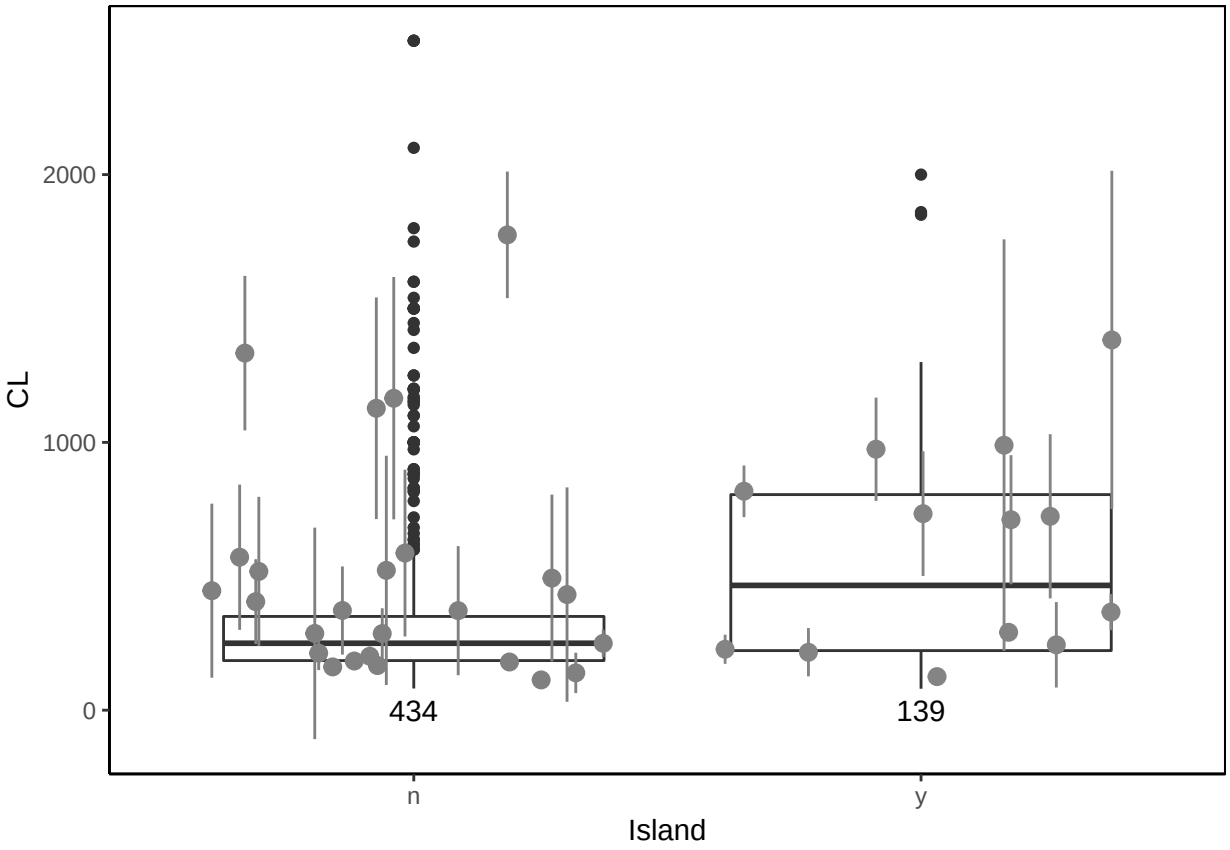

Figure 10: Boxplot continental vs. insular, genera summarised

continental vs. insular per time bin

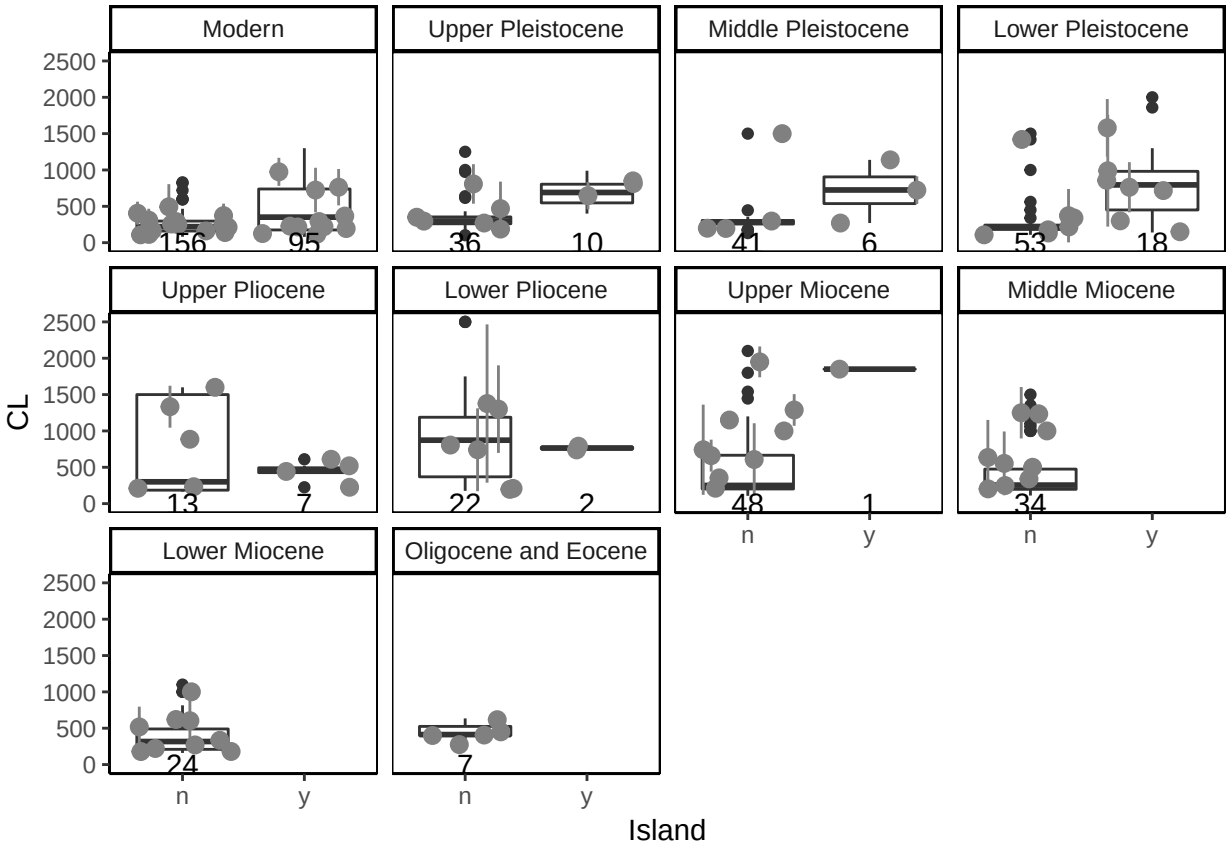

Figure 11: Boxplot continental vs. insular, genera summarised

continents

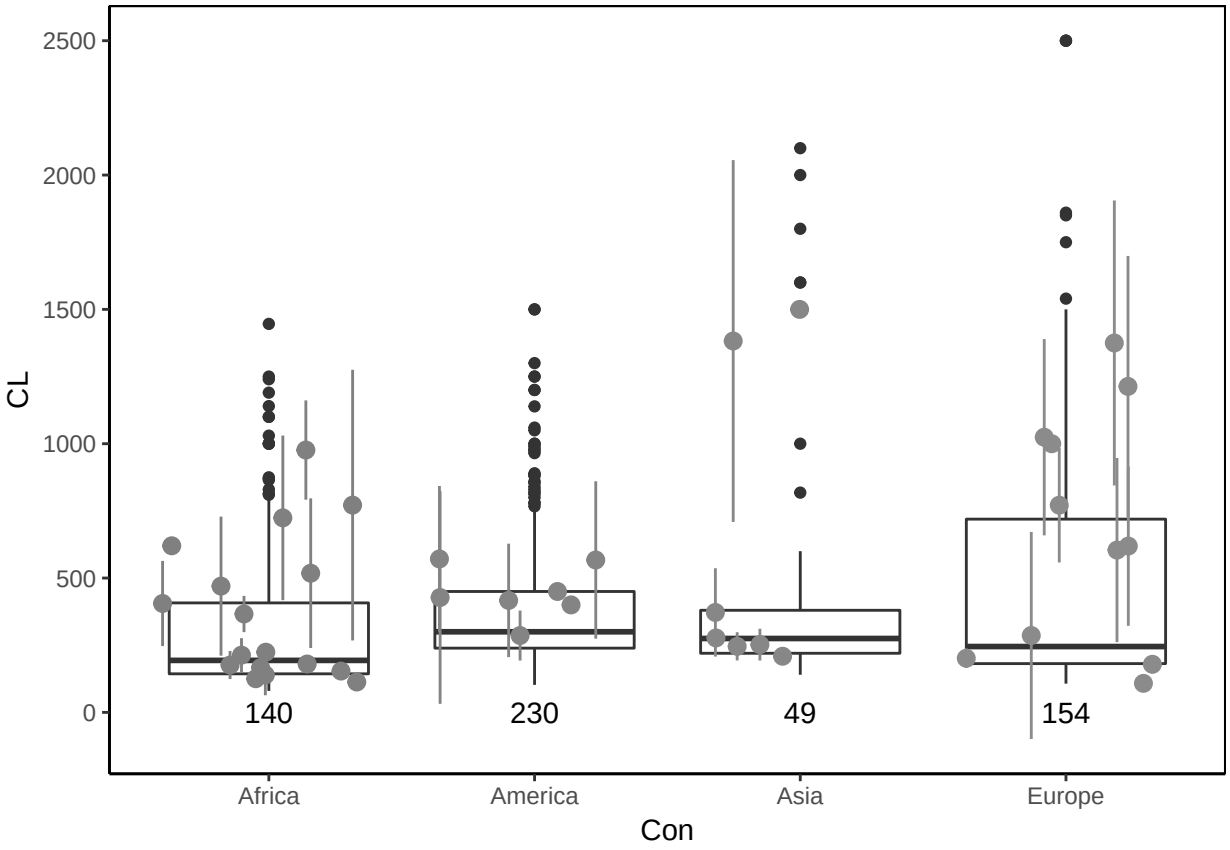

Figure 12: Boxplot: body size on different continents, genera summarised

paleoTS analysis

all (continental and insular)

individuals (all)

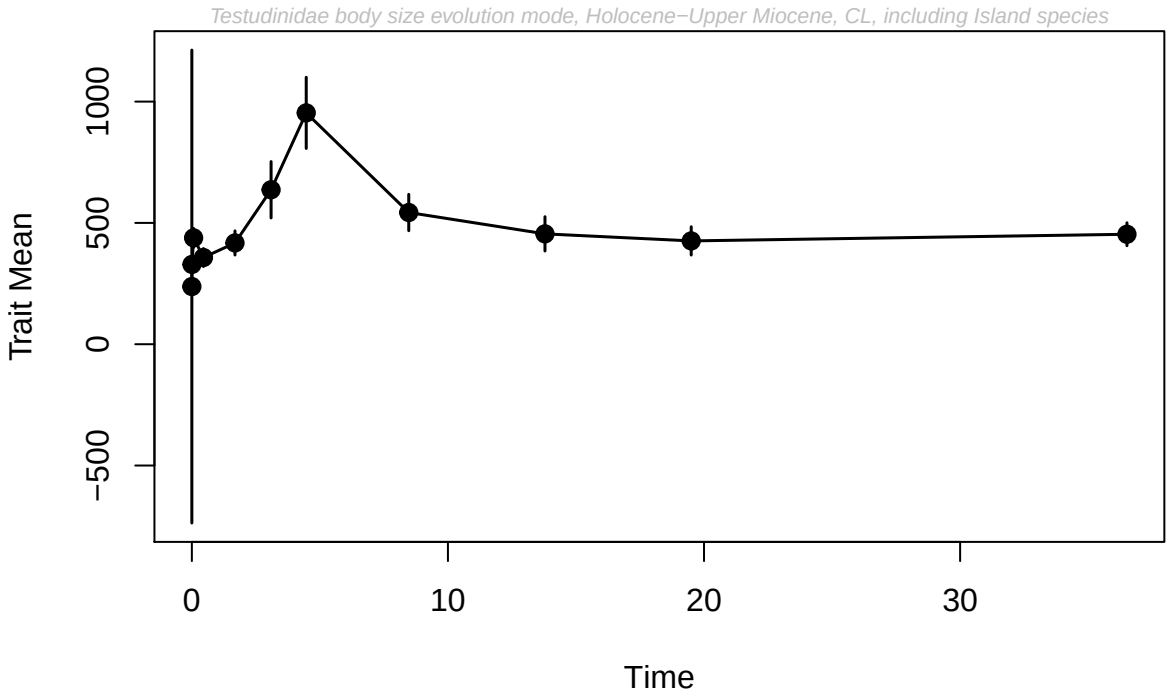

Figure 13: individuals, including island species

Table 3: Model-fitting results for testudinidae, individuals, including island species

	logL	K	AICc	Akaike.wt
GRW	-68.07841	2	141.8711	0.008
URW	-68.07845	1	138.6569	0.040
Stasis	-63.29025	2	132.2948	0.952

species (all)

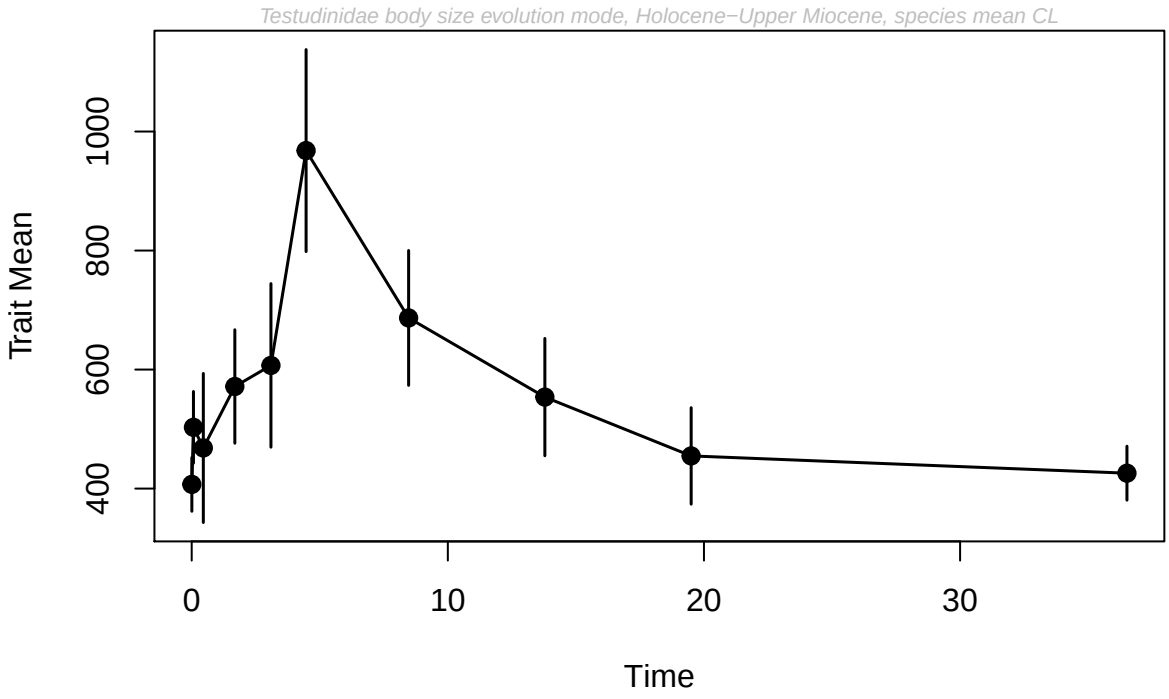

Figure 14: paleoTS plot with species mean, including island species

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

	logL	K	AICc	Akaike.wt
GRW	-56.70310	2	119.4062	0.149
URW	-56.93847	1	116.4484	0.653
Stasis	-56.41523	2	118.8305	0.198

genera (all)

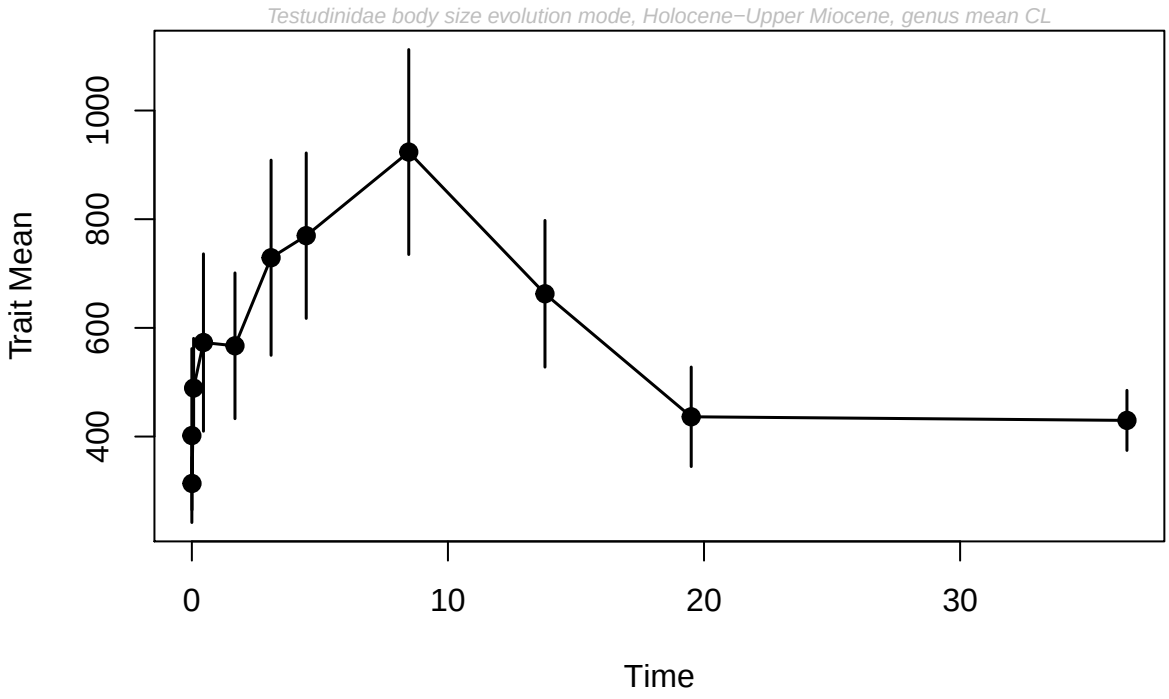

Figure 15: paleoTS plot with genus mean, including island species

Table 5: Model-fitting results for testudinidae, genera, including island species

	logL	K	AICc	Akaike.wt
GRW	-64.78186	2	135.2780	0.166
URW	-64.86224	1	132.2245	0.766
Stasis	-65.68705	2	137.0884	0.067

continental (excluding insular species)

individuals (continental)

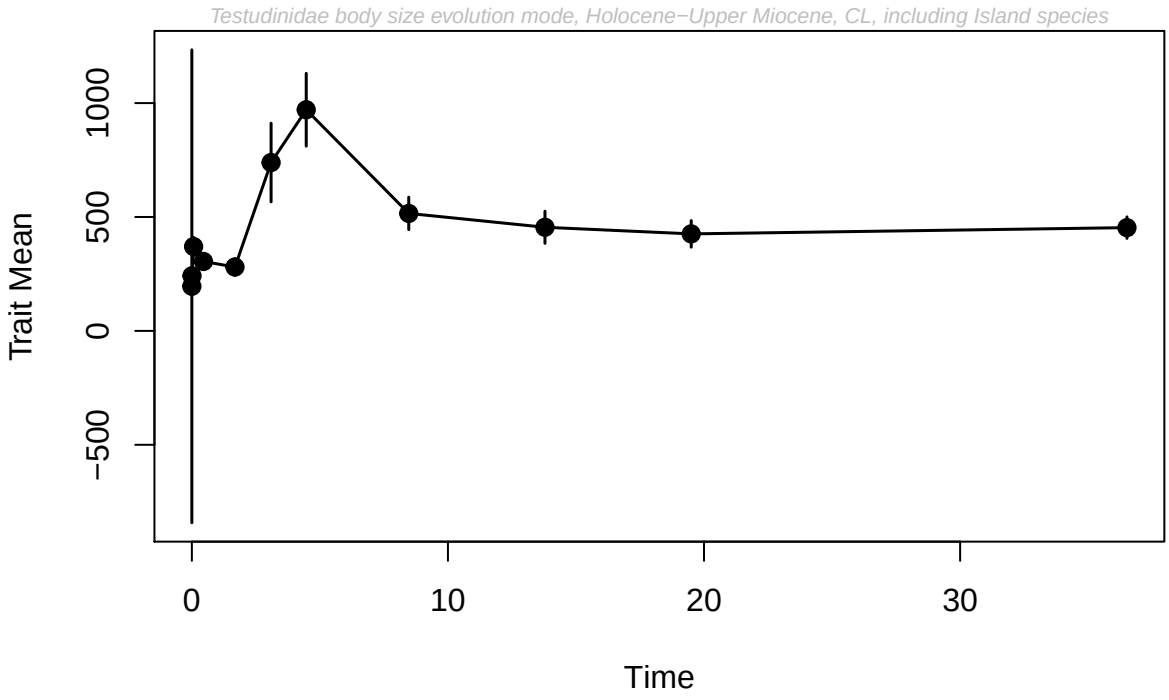

Figure 16: individuals, excluding island species

Table 6: Model-fitting results for testudinidae, individuals, excluding island species

	logL	K	AICc	Akaike.wt
GRW	-70.13728	2	145.9888	0.018
URW	-70.14070	1	142.7814	0.090
Stasis	-66.24073	2	138.1957	0.892

species (continental)

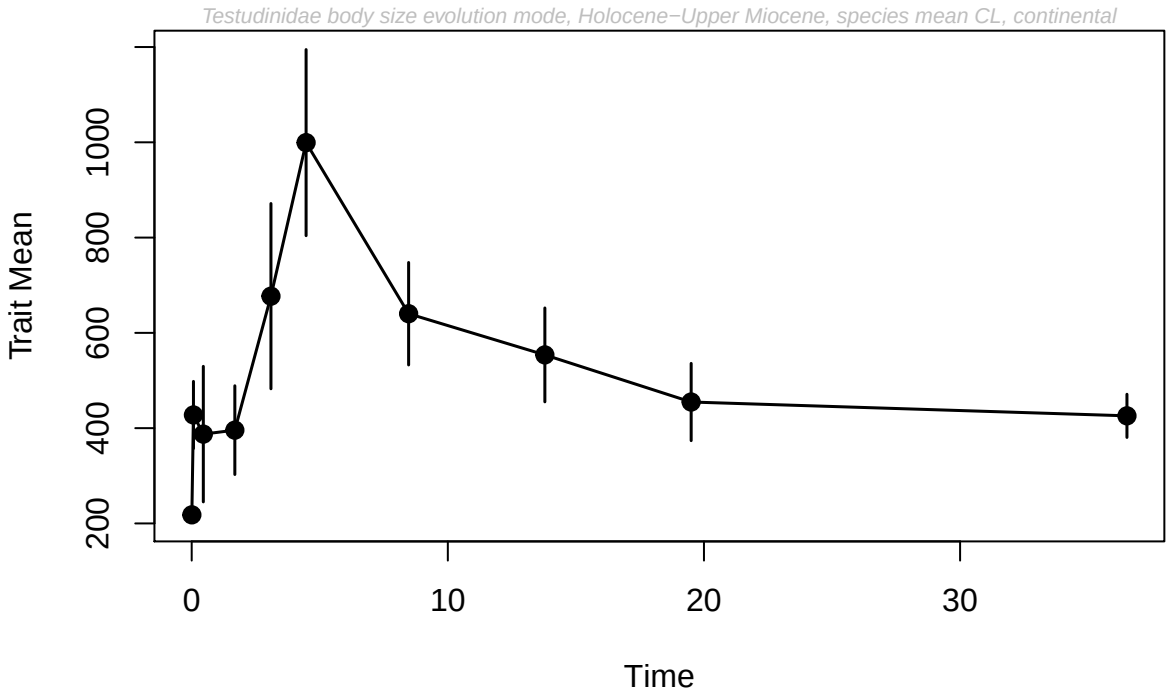

Figure 17: paleoTS plot with species mean, excluding island species

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

	logL	K	AICc	Akaike.wt
GRW	-60.91398	2	127.8280	0.020
URW	-62.36871	1	127.3088	0.026
Stasis	-57.04727	2	120.0945	0.954

genera (continental)

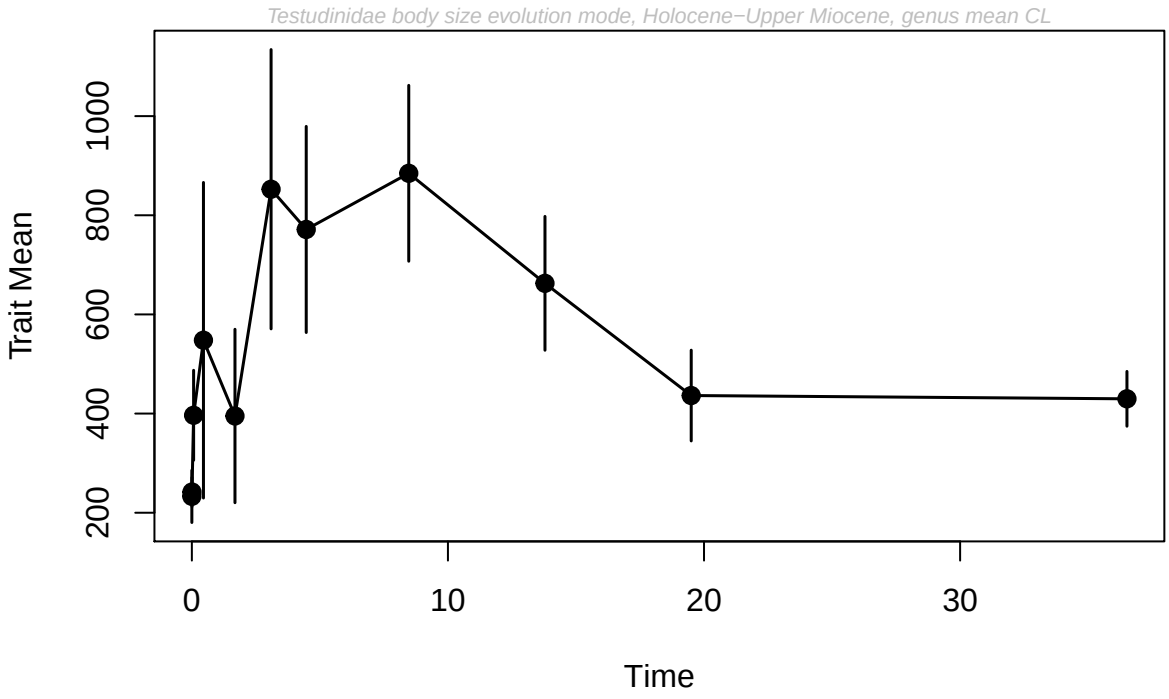

Figure 18: paleoTS plot with genus mean, excluding island species

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

	logL	K	AICc	Akaike.wt
GRW	-65.94462	2	137.6035	0.175
URW	-66.03667	1	134.5733	0.796
Stasis	-67.73195	2	141.1782	0.029

insular (excluding continental)

individuals (insular)

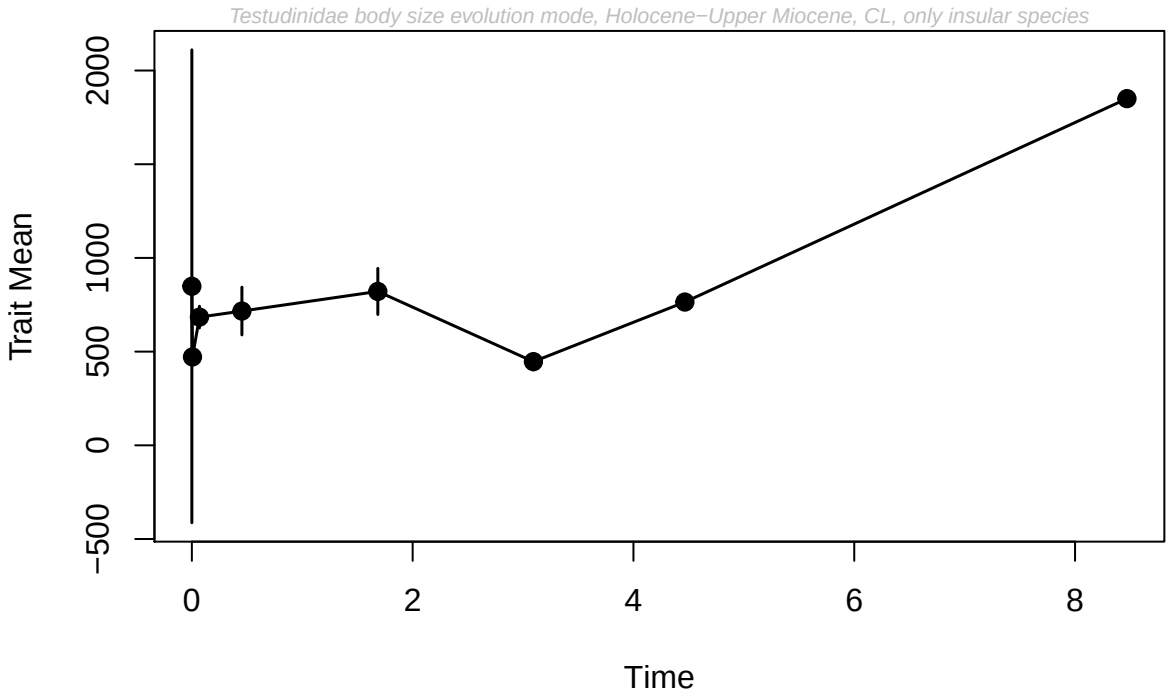

Figure 19: individuals, excluding continental species

Table 9: Model-fitting results for testudinidae, individuals, only insular species

	logL	K	AICc	Akaike.wt
GRW	-62.23202	2	131.4640	0.000
URW	-52.89195	1	108.5839	0.999
Stasis	-58.14309	2	123.2862	0.001

species (insular)

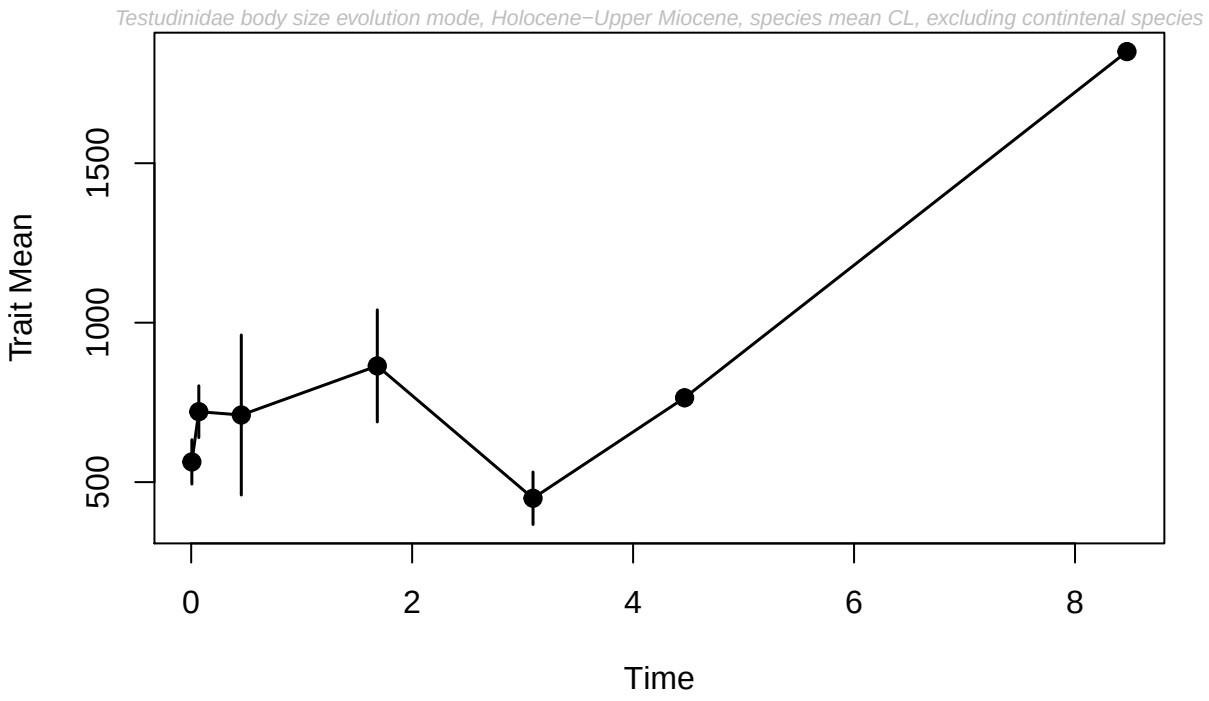

Figure 20: paleoTS plot with species mean, only insular species

Table 10: Model-fitting results for testudinidae, species, only insular species

	logL	K	AICc	Akaike.wt
GRW	-60.91398	2	127.8280	0.020
URW	-62.36871	1	127.3088	0.026
Stasis	-57.04727	2	120.0945	0.954

genera (insular)

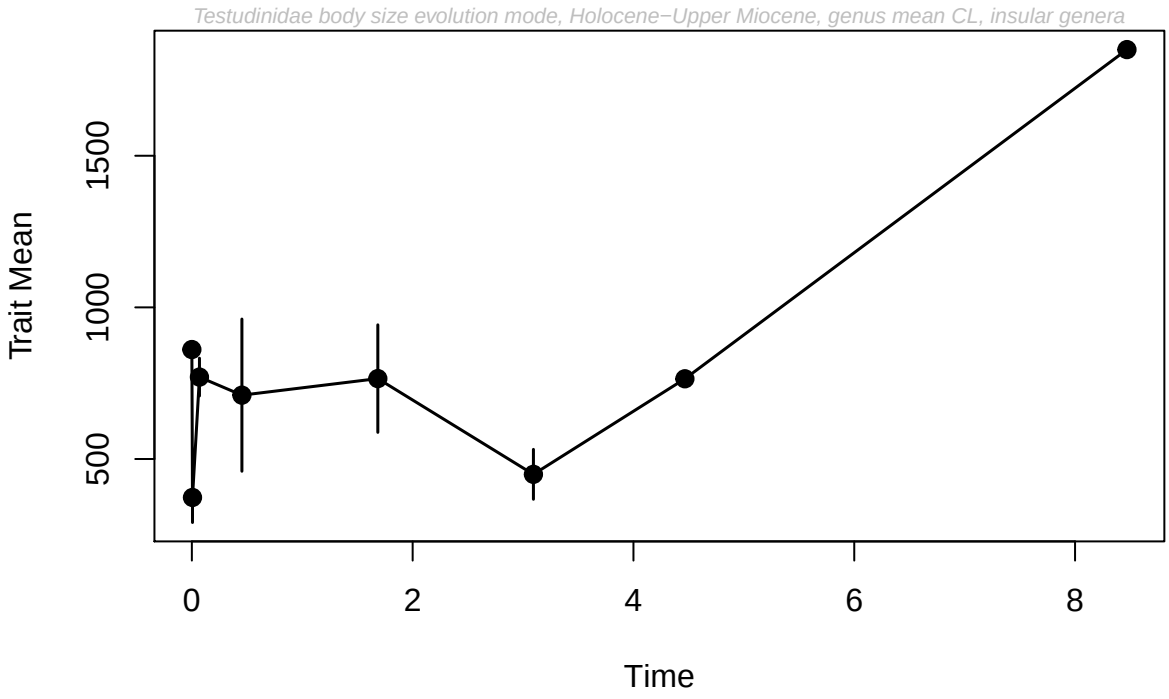

Figure 21: paleoTS plot with genus mean, only insular species

Table 11: Model-fitting results for testudinidae, genera, only insular species

	logL	K	AICc	Akaike.wt
GRW	-60.79557	2	128.5911	0
URW	-67.79820	1	138.3964	0
Stasis	-52.91882	2	112.8376	1

play with time bins: no bins (mean age of each sample == tt)

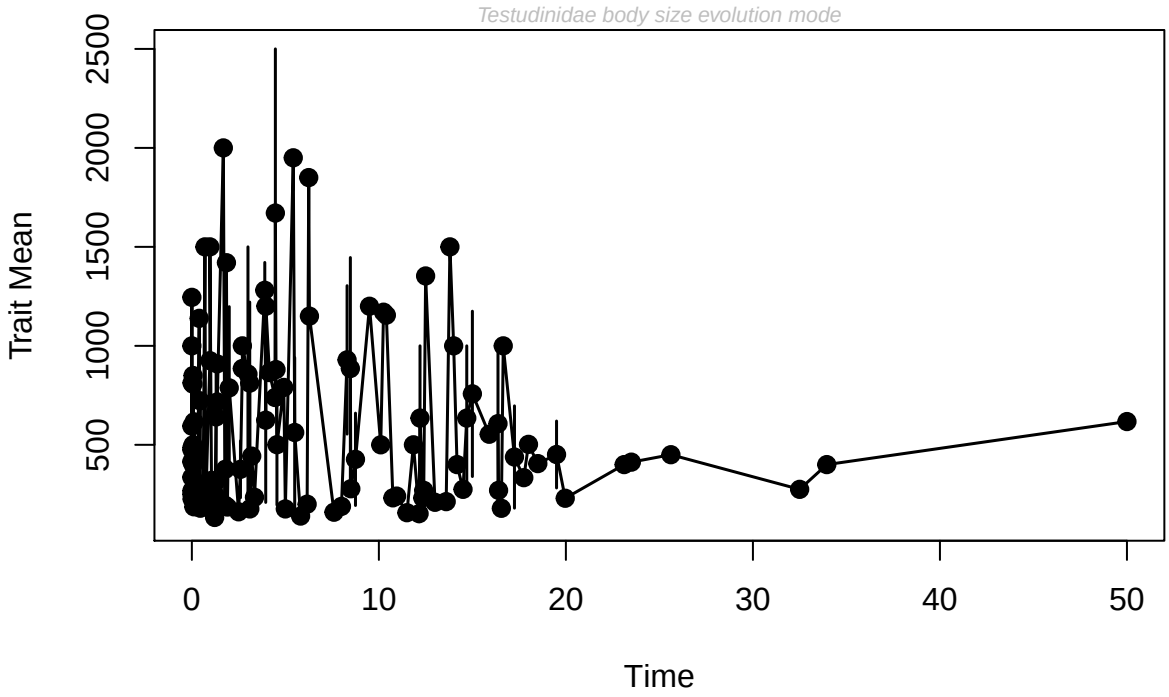

Figure 22: Mean age of each sample as time bin, genera

Table 12: Model-fitting results for testudinidae, no bins, genera

	logL	K	AICc	Akaike.wt
GRW	-963.1184	2	1930.347	0
URW	-963.0117	1	1928.060	0
Stasis	-841.6458	2	1687.402	1

Equal time bins

individuals (equal bins)

Table 13: Time bins with age range, epoch name, mean age and corresponding sample sizes (on individual, species and genus level)

tt	mm	vv	nn
0.00025	312.3935	59397.2190	240
0.50025	443.0221	92434.1831	106
1.50000	408.7154	166210.0663	65
2.50000	511.5214	250980.0218	14
3.50000	855.4545	491968.4502	22
4.50000	856.8167	442457.0942	12
5.50000	898.4286	665399.2857	7
6.50000	1066.6667	685833.3333	3
7.50000	169.3333	290.0833	3
8.50000	439.0000	143244.5625	25
9.50000	1200.0000	0.0000	1
10.50000	633.0000	182138.8440	6
11.50000	225.6000	24395.8000	5
12.50000	297.8450	95170.7552	20
13.50000	904.3333	420956.3333	3
14.50000	662.1286	187942.8824	7
15.50000	553.3333	192533.3333	3
16.50000	532.6600	183446.2780	5
17.50000	410.2308	80269.6923	13
18.50000	405.0000	2450.0000	2
19.50000	353.5000	32382.3333	4
23.50000	406.2500	78.1250	2
25.50000	450.0000	0.0000	1
32.50000	275.0000	0.0000	1
33.50000	400.0000	0.0000	1

tt	mm	vv	nn
49.50000	617.5000	612.5000	2

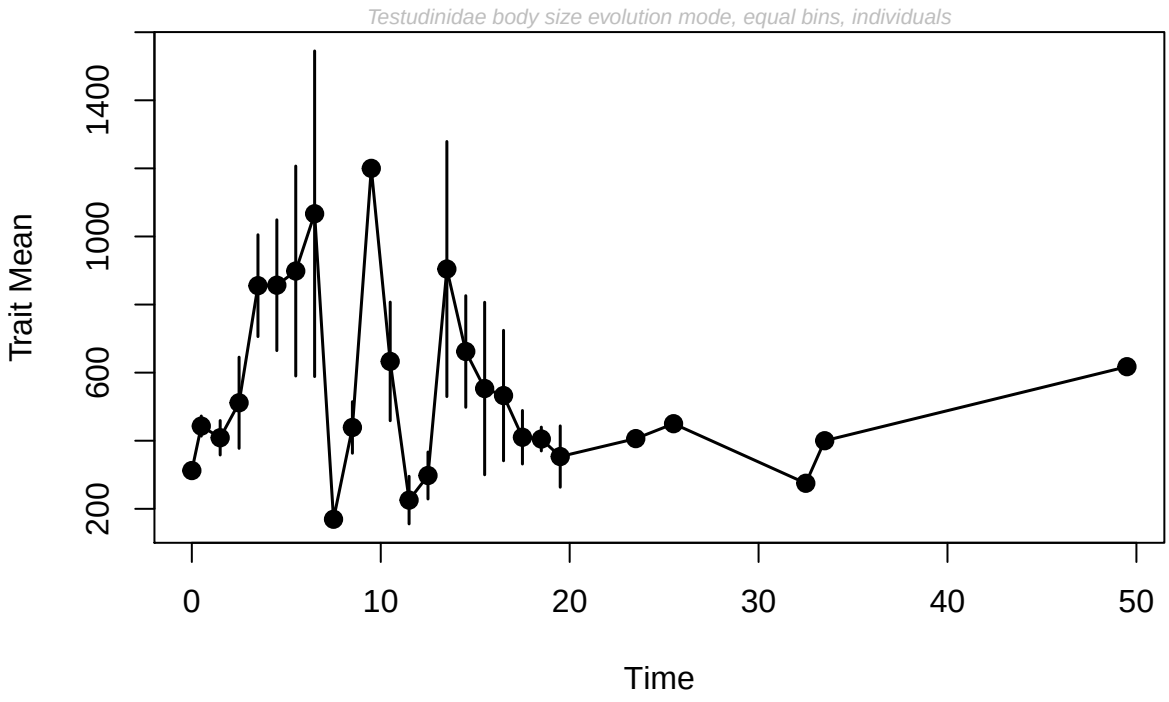

Figure 23: Equal bins, individuals

Table 14: Model-fitting results for testudinidae, equal time bins, individuals

	logL	K	AICc	Akaike.wt
GRW	-181.0860	2	366.7174	0.001
URW	-182.5837	1	367.3413	0.001
Stasis	-174.2101	2	352.9656	0.998

species (equal bins)

Table 15: Time bins with age range, epoch name, mean age and corresponding sample sizes (on individual, species and genus level)

tt	mm	vv	nn
0.00025	397.6667	96349.541	58
0.50025	561.9257	113439.136	27
1.50000	620.6031	318426.391	23
2.50000	505.6300	220722.247	10
3.50000	685.2500	336444.138	11
4.50000	951.2000	525502.647	9
5.50000	803.6250	719333.562	4
6.50000	1066.6667	685833.333	3
7.50000	174.2500	435.125	2
8.50000	659.7000	290503.185	9
9.50000	1200.0000	0.000	1
10.50000	633.0000	182138.844	6
11.50000	328.5000	58824.500	2
12.50000	498.0192	226588.614	7
13.50000	904.3333	420956.333	3
14.50000	576.6500	161906.135	6
15.50000	553.3333	0.000	1
16.50000	532.6600	183446.278	5
17.50000	428.2292	49344.877	4
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

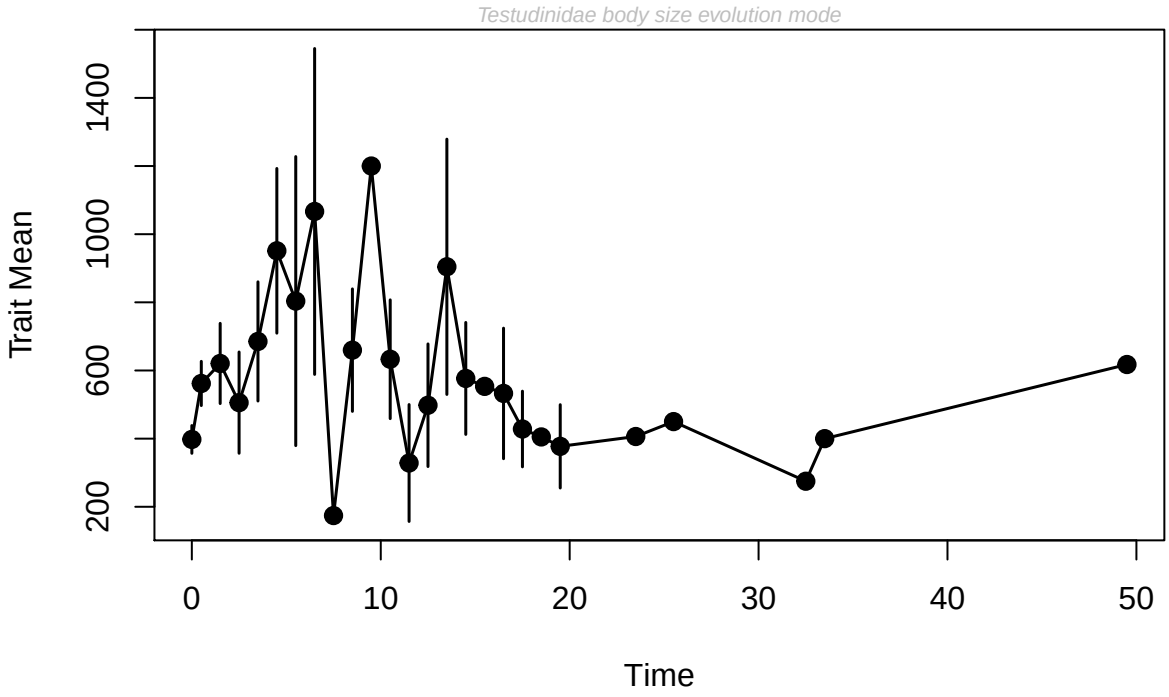

Figure 24: Equal bins, species

Table 16: Model-fitting results for testudinidae, equal time bins, species

	logL	K	AICc	Akaike.wt
GRW	-177.3909	2	359.3272	0.011
URW	-178.7626	1	359.6991	0.010
Stasis	-172.9454	2	350.4363	0.979

genera (equal bins)

Table 17: Time bins with age range, epoch name, mean age and corresponding sample sizes (on individual, species and genus level)

tt	mm	vv	nn
0.00025	335.6380	49292.698	17
0.50025	547.6849	98246.139	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	1200.0000	0.000	1
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	624.4800	183271.727	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

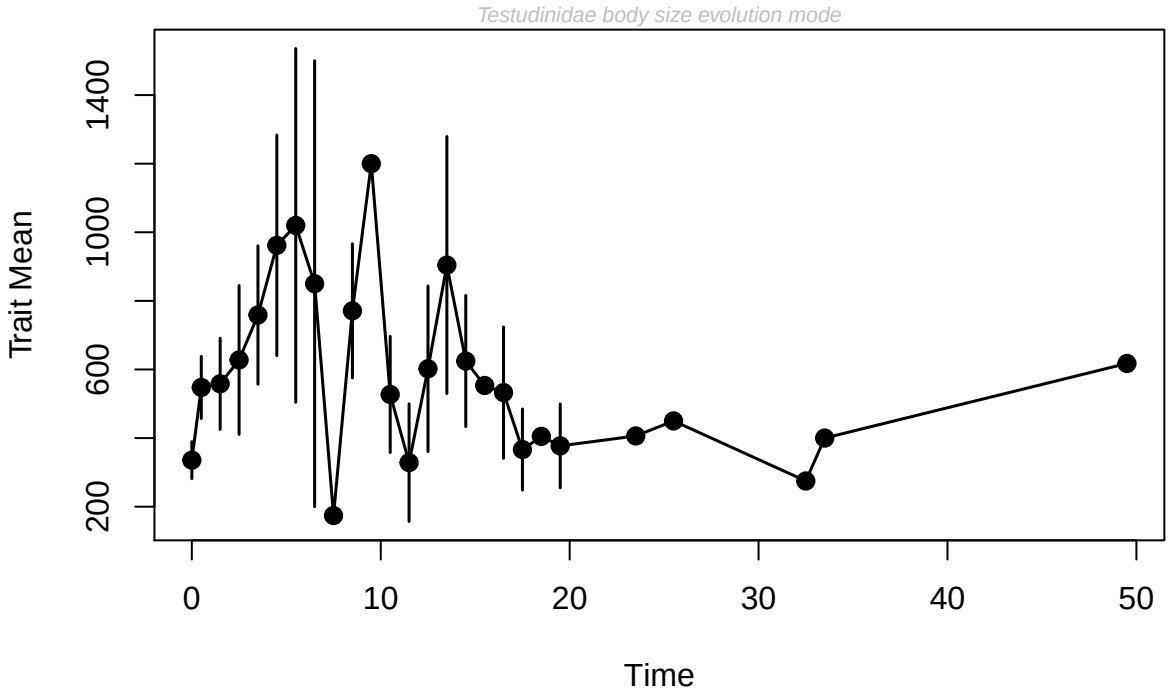

Figure 25: Equal bins, genera

Table 18: Model-fitting results for testudinidae, equal time bins, genera

	logL	K	AICc	Akaike.wt
GRW	-179.4504	2	363.4462	0.008
URW	-178.8180	1	359.8099	0.051
Stasis	-174.7233	2	353.9921	0.940

larger equal bins

genera (larger equal bins)

Table 19: Time bins with age range, epoch name, mean age and corresponding sample sizes (on individual, species and genus level)

tt	mm	vv	nn
0.5	404.7783	74680.998	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	1200.0000	0.000	1
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	624.4800	183271.727	5
15.5	553.3333	0.000	1

tt	mm	vv	nn
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

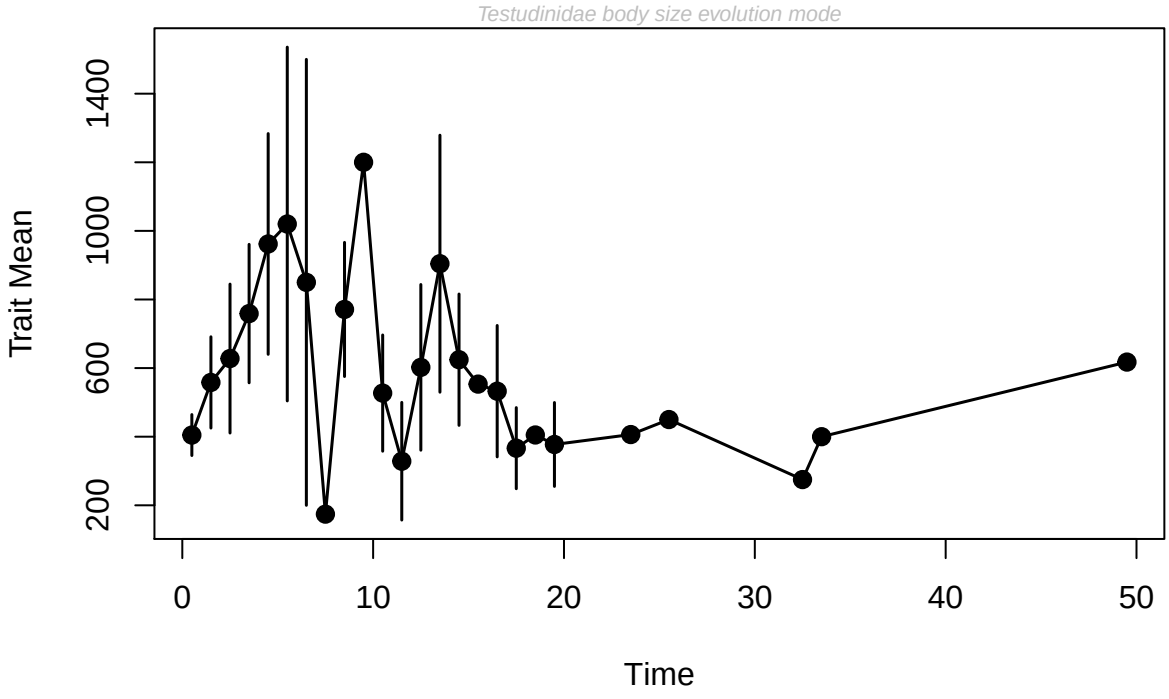

Figure 26: Larger equal bins, genera

Table 20: Model-fitting results for testudinidae, larger equal time bins, genera

	logL	K	AICc	Akaike.wt
GRW	-172.6279	2	349.8272	0.036
URW	-172.9972	1	348.1763	0.082
Stasis	-169.4260	2	343.4234	0.882

per continent

Africa, individuals

Table 21: paleoTS object (mm= mean CL, nn = sample size, vv = variance (CL), tt = Age)

mm	nn	vv	tt
848.6396	111	176705032.40	0.0000005
315.7257	113	84989.64	0.0058500
132.0000	1	0.00	0.4535000
192.3000	6	11633.02	1.6845000
1000.0000	1	0.00	3.0940000
0.0000	4	0.00	4.4660000
1446.0000	1	0.00	8.4700000
412.2000	15	73921.74	19.5000000

Table 22: Model-fitting results for testudinidae, individuals, Africa

	logL	K	AICc	Akaike.wt
GRW	-69.73883	2	146.4777	0.00
URW	-62.56518	1	127.9304	0.99
Stasis	-65.08256	2	137.1651	0.01

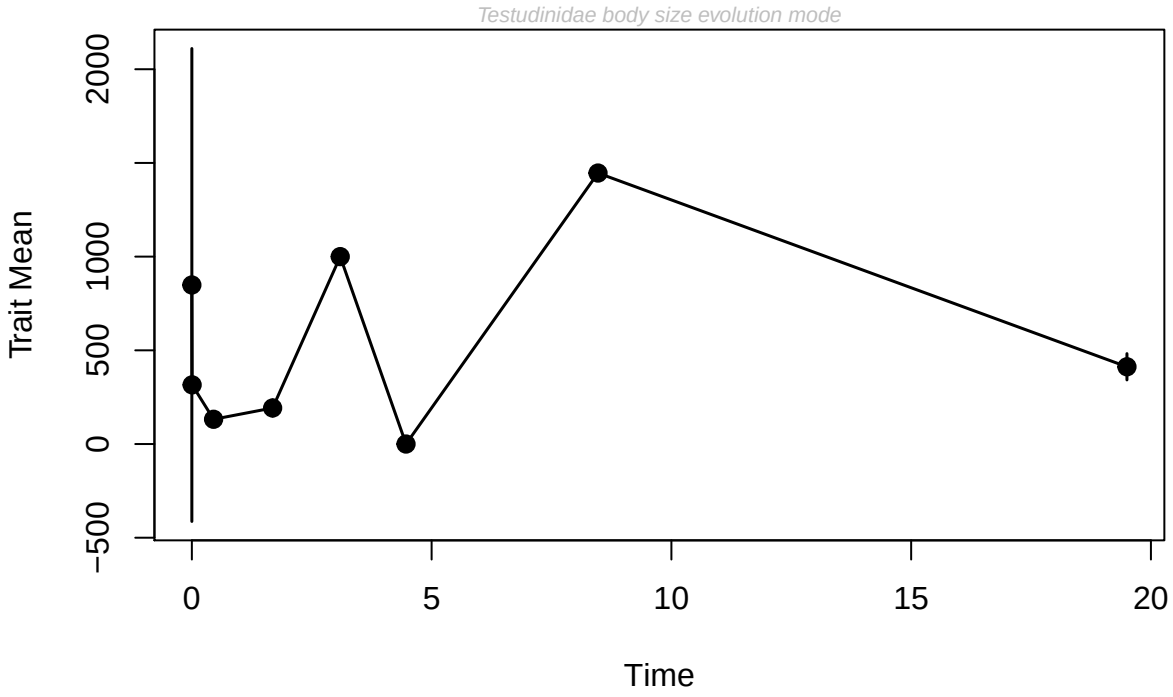

Figure 27: Africa, individuals

Europe, individuals

Table 23: paleoTS object (mm= mean CL, nn = sample size, vv = variance (CL), tt = Age)

mm	nn	vv	tt
187.3771	35	3707.446	0.00585
616.6667	3	138802.333	0.06885
377.8167	12	75333.898	0.45350
731.5786	14	306198.902	1.68450
0.0000	6	0.000	3.09400
1283.1429	14	566267.670	4.46600
0.0000	35	0.000	8.47000
0.0000	30	0.000	13.78900
482.2167	6	162024.202	19.50000
489.5000	5	13832.500	36.51500

Table 24: Model-fitting results for testudinidae, individuals, Europe

	logL	K	AICc	Akaike.wt
GRW	-73.23814	2	152.4763	0.001
URW	-74.54846	1	151.6683	0.002
Stasis	-66.43459	2	138.8692	0.997

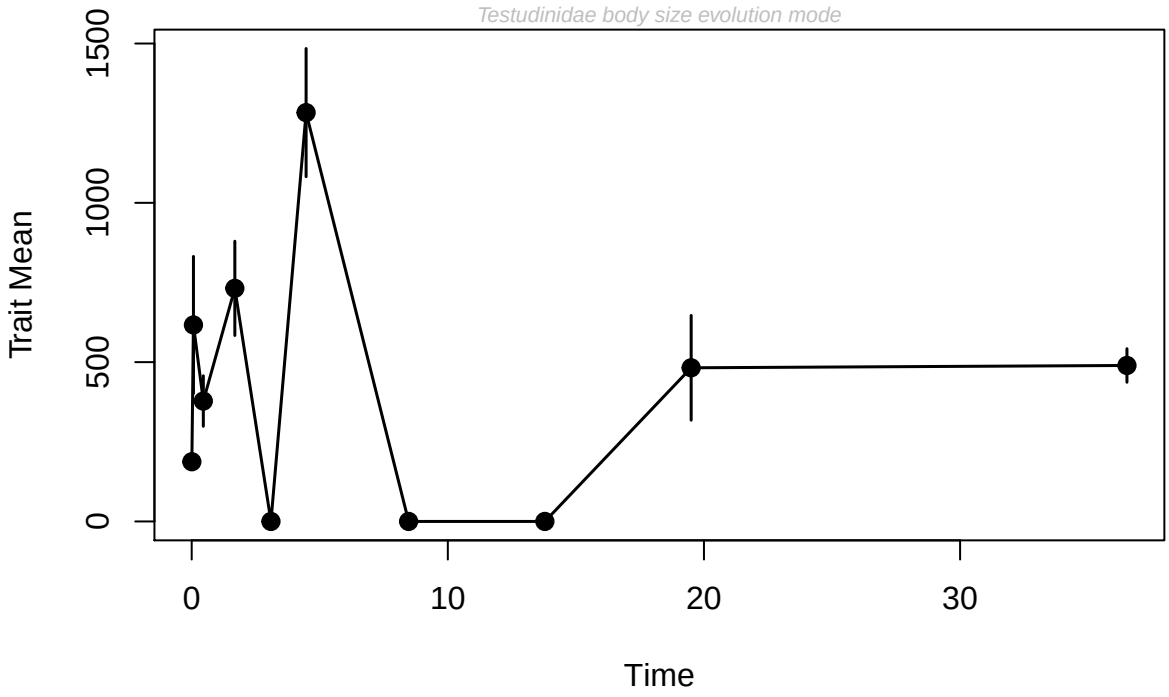

Figure 28: Europe, individuals

America, individuals

Table 25: paleoTS object (mm= mean CL, nn = sample size, vv = variance (CL), tt = Age)

mm	nn	vv	tt
254.5369	807	389794806.8	0.0000005
0.0000	69	0.0	0.0058500
0.0000	43	0.0	0.0688500
0.0000	35	0.0	0.4535000
0.0000	49	0.0	1.6845000
0.0000	12	0.0	3.0940000
0.0000	9	0.0	4.4660000
467.4214	14	117249.1	8.4700000
0.0000	8	0.0	13.7890000
0.0000	4	0.0	19.5000000
450.0000	1	0.0	36.5150000

Table 26: Model-fitting results for testudinidae, individuals, America

	logL	K	AICc	Akaike.wt
GRW	-64.72009	2	135.1545	0.130
URW	-64.43046	1	131.3609	0.864
Stasis	-67.81075	2	141.3358	0.006

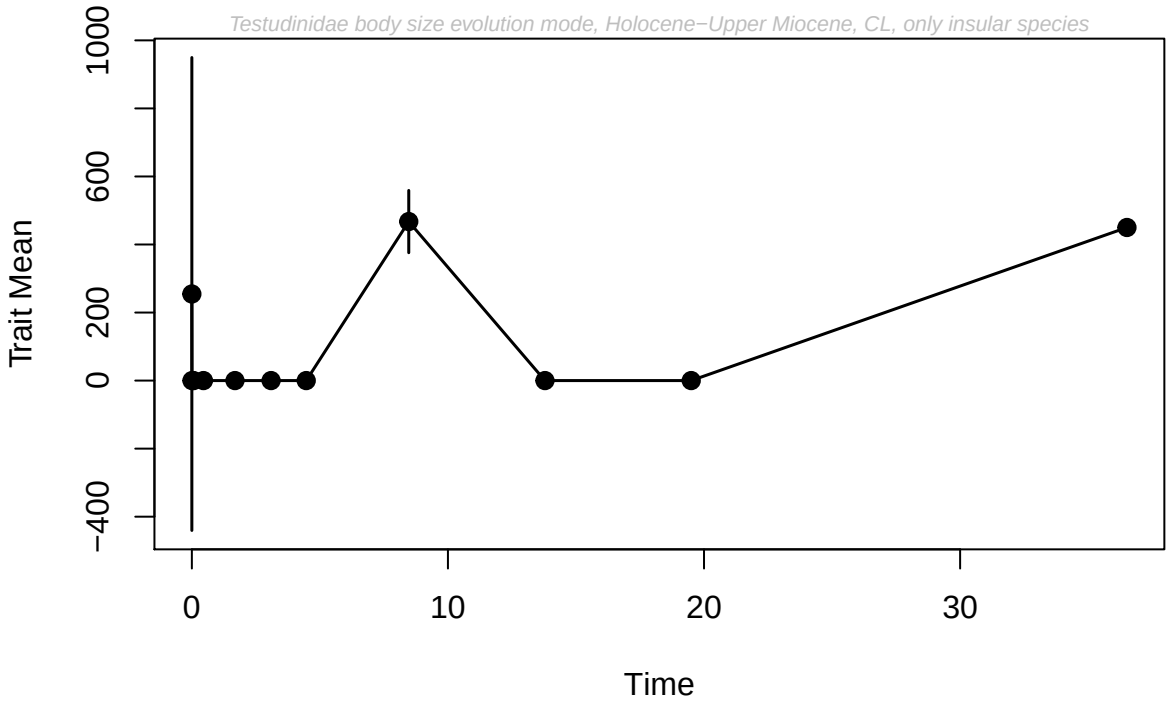

Figure 29: America, individuals

Asia, individuals

Table 27: paleoTS object (mm= mean CL, nn = sample size, vv = variance (CL), tt = Age)

mm	nn	vv	tt
137.2637	810	3.088779e+09	0.0000005
279.0800	35	1.026795e+04	0.0058500
270.0000	1	0.000000e+00	0.0688500
989.5000	4	5.907610e+05	1.6845000
1550.0000	4	3.333333e+03	3.0940000
209.0000	2	2.420000e+02	4.4660000
1950.0000	2	4.500000e+04	8.4700000
275.0000	1	0.000000e+00	36.5150000

Table 28: Model-fitting results for testudinidae, individuals, Asia

	logL	K	AICc	Akaike.wt
GRW	-80.46824	2	167.9365	0
URW	-58.38546	1	119.5709	1
Stasis	-66.94216	2	140.8843	0

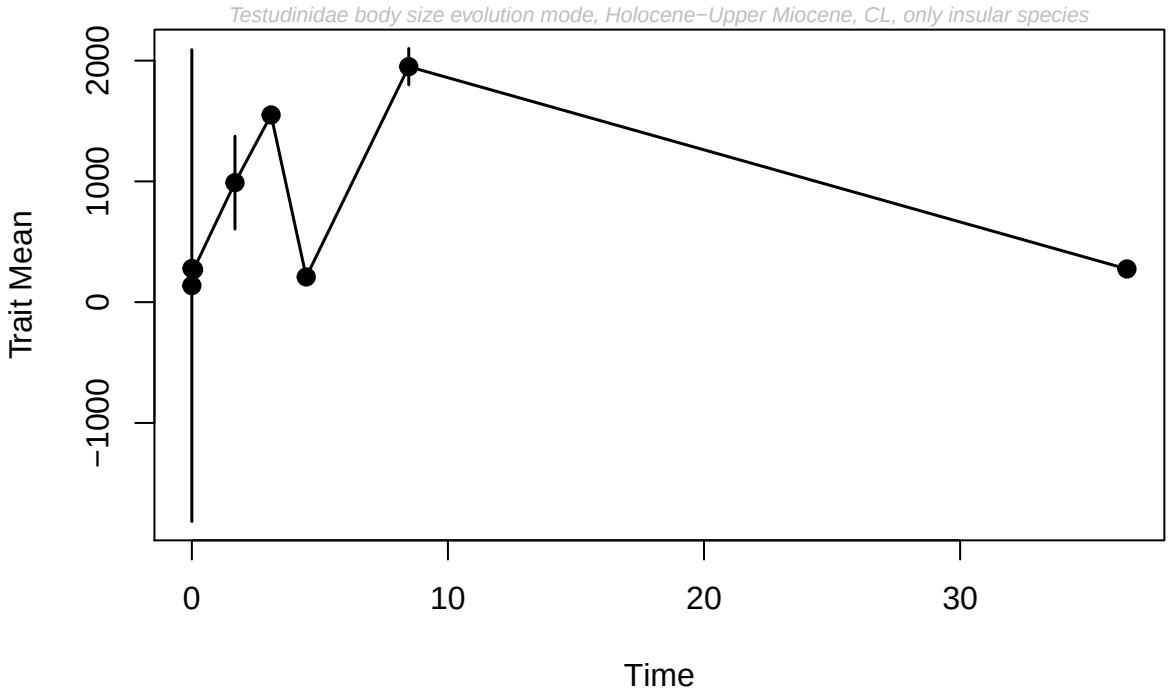

Figure 30: individuals, Asia

Eurasia, individuals

Table 29: paleoTS object (mm= mean CL, nn = sample size, vv = variance (CL), tt = Age)

mm	nn	vv	tt
137.2637	810	3.088779e+09	0.0000005
233.2286	70	9.019250e+03	0.0058500
530.0000	4	1.225793e+05	0.0688500
377.8167	12	7.533390e+04	0.4535000
788.8944	18	3.505783e+05	1.6845000
891.1111	9	4.104549e+05	3.0940000
1148.8750	16	6.253894e+05	4.4660000
547.2971	34	3.263311e+05	8.4700000
448.7464	28	1.911266e+05	13.7890000
482.2167	6	1.620242e+05	19.5000000
453.7500	6	1.873438e+04	36.5150000

Table 30: Model-fitting results for testudinidae, individuals, Asia

	logL	K	AICc	Akaike.wt
GRW	-73.47268	2	152.6596	0.101
URW	-73.64757	1	149.7951	0.425
Stasis	-71.93258	2	149.5794	0.473

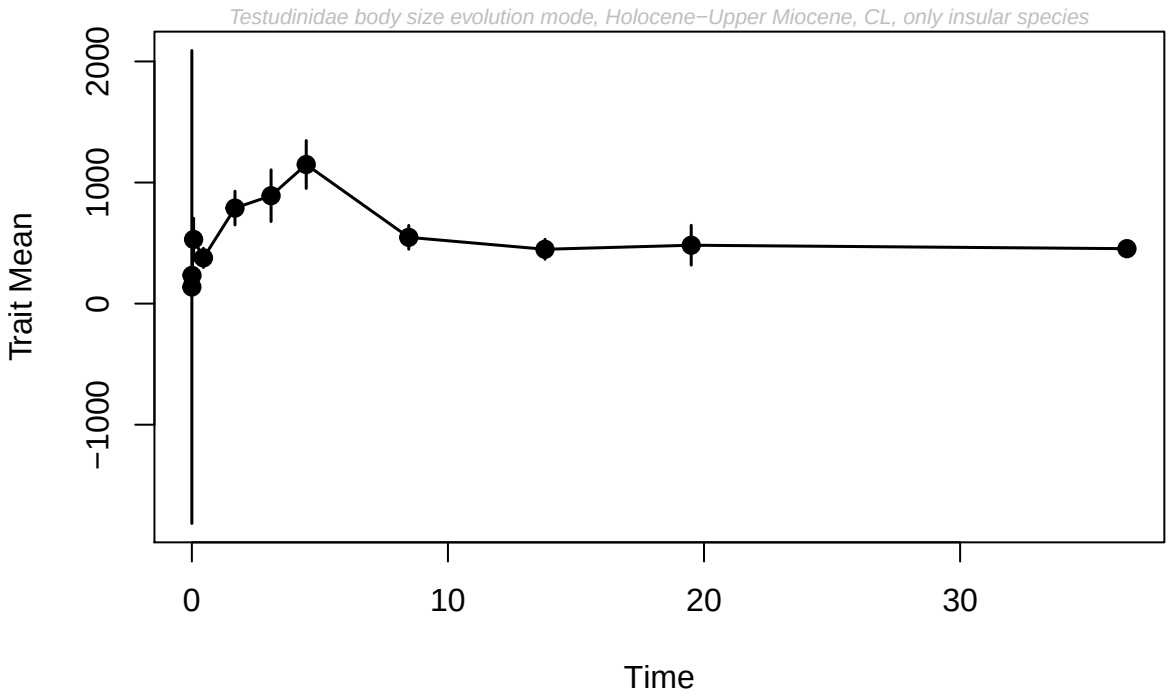

Figure 31: individuals, Eurasia