Ecography

ECOG-04596

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Appendix 1

Sensitivity analyses

To test whether our selection and standardization of molars elements for mass estimation led to biases in our analysis, we ran several sensitivity analyses. First, we included all data, without the exclusion of potential duplicates or subadults, processed as described within the methods of the main text. Second, we reran analyses on all data but excluded potential subadults. Finally, we ran analyses on single elements, either upper or lower molars.

We conducted the analyses across both our pre- (12700-15800 cal BP) versus post- (0-12 700 cal BP) extinction bins, and then across our 14-time intervals to test whether the inclusion of only lower or only upper molars changed the results we obtained from using minimum number of individuals (MNI) and a standardization of upper molars to estimate body size. This analysis therefore contained all 399 specimens for which we obtained molar length measurements, and were divided into 230 lower molar measurements and 169 upper molar measurements, including both left and right orientations. We analyzed variation across our pre- and post-extinction bins using the F-test and Two-sample T-test, and considered changes across our 14-time intervals using ANOVAs and Tukey Multiple Comparisons.

Analyses using all 399 mass estimates gave the same results as those given by data analyzed after applying our MNI, independent of whether subadults were maintained or removed. Analysis of all data, including potential duplicate individuals and subadults, found no significant change in the variation or distribution of mass across our pre- and post-extinction time intervals (F-test $p>0.05$, df=12/385, two sample T-test $p>0.1$, df=397) or across our 14-time intervals (ANOVA $p>0.1$, df=13/385). Similar results were obtained when subadults were removed both for the pre- and post-extinction bins (F-test $p>0.05$, df=12/368, two sample T-test $p>0.1$, df=380) and 14-time intervals (ANOVA $p>0.1$, df=13/368).

Our results were consistent across lower and upper molars and those obtained using our MNI selection criteria, even with the inclusion of subadults. Analysis for pre- and post-extinction time intervals found no significant change in variation or distribution of mass as given by lower molar length (F-test $p>0.1$, df=5/223, two sample T-test $p>0.1$, df=228) or upper molar length (F-test $p>0.1$, df=6/161, two sample T-test $p>0.1$, df=167).

No significant differences were found across adjacent or non-adjacent 14-time intervals when only lower molar lengths were used (ANOVA $p>0.1$, df = 13/216). No significant differences were found across adjacent time intervals, but a single significant change in body size was found between non-adjacent time intervals for upper molars (ANOVA df=13/155, p-value<0.05, Tukey p-value<0.05 for time intervals 1500-3100 and 8400-9000 cal BP). This difference was found to be driven by a single outlier. Thus, the use of a single element did not alter our overall results, but because temporal bins were lost or low, it would compromise our ability to do other analyses, such as with our state space models.

Table A1. *Sigmodon* elements present within each time interval as given by stratigraphic depth (cm) and age range (cal BP). Elements included mandibles, maxilla or loose molars designated as follows: lower left first molar (LLM1), lower right first molar (LRM1), upper left first molar (ULM1) and upper right first molar (URM1). Mandibles or maxilla without first molars are designated as "other". "Total" are all molar measurements taken (N=399) across all time intervals. "Used in Analysis" is the number of molar measurements included after removal of potential duplicates using minimum number of individuals and removal of potential subadults. The age range comes from the age model presented in Supplementary materials Appendix 1 Figure A1, Table A2.

		Sigmodon elements present					Molar lengths	
Stratigraphic depth (cm)	Age range (cal BP)	LLM1	LRM1	ULM1	URM1	Other	Total	Used in analysis
0 - 10	0 - 1500	2	8	5	2	4	17	14
10 - 35	1500 - 3100	6	5	6	8	8	25	18
35 - 70	3100 - 5400	6	3	5	3	5	17	13
70 - 80	5400 - 6100	4	8	5	3	8	20	13
80 - 85	6100 - 6400	6	6	2	7	14	21	13
85 - 90	6400 - 6700	12	7	6	3	1	28	19
90 - 105	6700 - 7700	8	9	3	1	15	21	16
105 - 115	7700 - 8400	12	11	9	3	7	35	25
115 - 125	8400 – 9000	19	11	12	15	16	57	34
125 - 130	9000 - 9400	3	2	9	8	4	22	15
130 - 140	9400 – 10 000	10	18	11	5	5	44	26
140 - 155	10 000 – 11 000	22	23	14	11	5	70	45
155 - 180	11 000 – 12 700	0	3	4	2	0	9	7
180 - 230	12 700 – 15 800	5	1	4	3	22	13	12

Age model

Table A2. Stratigraphic depth, specimen id(s), AMS ^{14}C measurements (RC y BP) and errors (RC ± 1σ), and calibrated ages (cal BP) and standard deviations. Mean calendar ages were calibrated using OxCal ver. 4.3.2 (Ramsey 1995, 2009, 2017) with 95% confidence intervals (2σ). Original AMS ^{14}C measurements from Toomey (1993), Cooke et al. (2003) and Bourne et al. (2016).

Stratigraphic depth (cm)	Depth midpoint (cm)	Specimen ID(s)	Material dated	RC (y BP)	RC (± 1σ)	Unmodelled mean calendar years (cal BP)	Unmodelled calendar years dtandard deviation (2σ)	Reference
Surface	0	41229-10880, Tx-7053	Guano	0	0	50	0	Toomey 1993
7	7	41229-10548, Tx-7191	Charcoal	420	60	442	68	Toomey 1993
005-010	7.5	41229-990, Tx-6943	Guano	1460	100	1384	97	Toomey 1993
015-020	17.5	41229-12115	Gelatin	1500	60	1407	65	Cooke et al. 2003
025-030	27.5	41229-12118	Gelatin	2330	60	2372	119	Cooke et al. 2003
040-045	42.5	CAMS-8738	Bone	2860	60	2989	86	Bourne et al. 2016
045-050	47.5	41229-1119, Tx-6097	Charcoal	2490	90	2560	116	Toomey 1993
050-055	52.5	41229-12083	Charcoal	3190	70	3414	85	Cooke et al. 2003
050-055	52.5	CAMS-8736	Bone	3250	60	3483	67	Bourne et al. 2016
055-060	57.5	41229-6881, Tx-6752	Charcoal	3190	90	3411	111	Toomey 1993
060-065	62.5	41229-12117	Gelatin	4000	60	4484	104	Cooke et al. 2003
070-075	72.5	CAMS-16024	Bone	4550	80	5201	137	Bourne et al. 2016
075-080	77.5	41229-12099	Humins	5400	70	6175	91	Cooke et al. 2003
080-085	82.5	CAMS-16022	Bone	4670	60	5415	87	Bourne et al. 2016
090-095	92.5	41229-12162	Gelatin	5320	60	6102	82	Cooke et al. 2003
100	100	41229-5265, Tx-6413	Charcoal	4850	130	5583	159	Toomey 1993
100-105	102.5	CAMS-16029	Bone	6110	60	7002	95	Bourne et al. 2016
105-110	107.5	41229-12164	Gelatin	7700	80	8497	74	Cooke et al. 2003
120-125	122.5	41229-12166	Gelatin	8630	60	9613	68	Cooke et al. 2003
130-135	132.5	CAMS-16162	Bone	8730	60	9728	118	Bourne et al. 2016
140-145	142.5	41229-6882, Tx-6537	Bone	7040	210	7889	196	Toomey 1993
145-150	142.5	41229-12080	Gelatin	10 310	70	12 137	156	Cooke et al. 2003

145-150	147.5	CAMS-8724	Bone	10 340	70	12 193	145	Bourne et al. 2016
155-158	157.5	41229-1360, Tx-6154	Carbonate	7190	120	8024	125	Toomey 1993
155-160	157.5	CAMS-33971	Bone	11 290	60	13 154	57	Bourne et al. 2016
155-160	157.5	41229-12075	Gelatin	11 310	60	13 168	57	Cooke et al. 2003
165-170	167.5	41229-12173	Gelatin	11 410	70	13 250	76	Cooke et al. 2003
175-180	177.5	CAMS-16018	Bone	11 460	60	13 306	70	Bourne et al. 2016
180	180	41229-1326, Tx-6137	Carbonate	11 850	120	13 688	139	Toomey 1993
185-190	187.5	41229-N.D.	Gelatin	11 550	70	13 383	67	Cooke et al. 2003
190-195	192.5	41229-1118, Tx-6096	Carbonate	11 770	150	13 618	162	Toomey 1993
195-200	197.5	41229-12176	Gelatin	12 110	90	13 971	127	Cooke et al. 2003
210-215	212.5	41229-12177	Gelatin	14 400	80	17 553	128	Cooke et al. 2003
220-225	225.5	41229-12073	Gelatin	12 570	80	14 843	210	Cooke et al. 2003
230-235	232.5	CAMS-7197	Bone	12 680	100	15 307	207	Bourne et al. 2016
230-235	232.5	41229-10879, Tx-7430	Bone	15 130	170	18 369	196	Toomey 1993
235-240	237.5	41229-12076	Gelatin	14 700	90	17 885	124	Cooke et al. 2003
260-260	260	41229-12137	Humic Acid	15 290	90	18 556	106	Cooke et al. 2003
270-275	272.5	41229-12179	Gelatin	13 940	100	16 897	180	Cooke et al. 2003
295-300	297.5	41229-12180	Gelatin	16 240	100	19 615	149	Cooke et al. 2003
300-305	302.5	41229-12181	Gelatin	16 620	110	20 054	158	Cooke et al. 2003
315-320	317.5	41229-12183	Gelatin	16 510	100	19 910	144	Cooke et al. 2003
338-342	340.5	41229-12131	Humic Acid	16 610	110	20 041	159	Cooke et al. 2003
345-350	347.5	41229-12184	Gelatin	16 770	100	20 236	139	Cooke et al. 2003

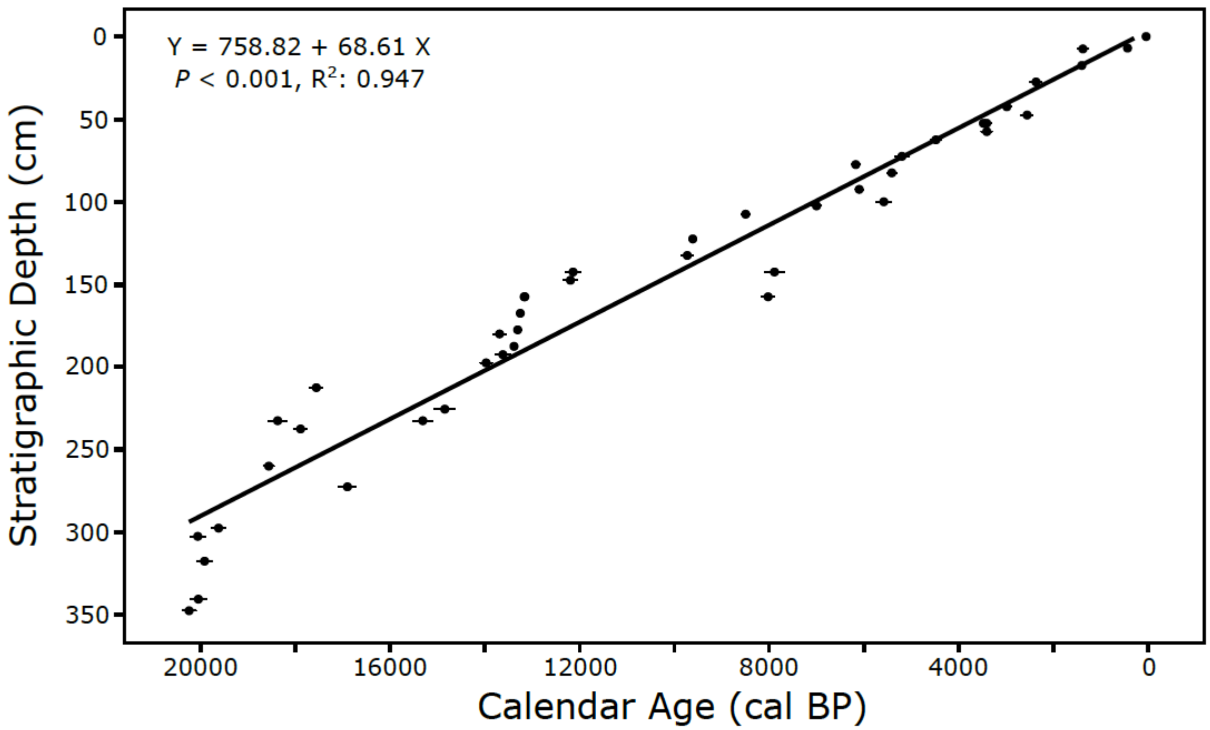

Figure A1. Age model of Hall's Cave. Regression of unmodelled calibrated calendar ages (cal BP) and stratigraphic depth (cm) of the Hall's Cave fossil record. Because elements were binned into 5-15cm units, the midpoint of the stratigraphic depth was employed in the regression. Black bars represent the 95% confidence intervals for each calibrated interval. A linear regression yielded an equation of Y = 758.82 + 64.57 X (df=42, p<0.001, adj. R^2=0.947).

Additional data

Table A3. Percent of each trophic category (browser, carnivore, frugivore/granivore, grazer, insectivore and omnivore) within the Edwards Plateau mammal community across the 14-time intervals.

	Percent (%) of trophic category within community					
Age range (cal BP)	Browser	Carnivore	Frugivore/granivore	Grazer	Insectivore	Omnivore
0 – 1500	29.4	20.6	14.7	11.8	11.8	11.8
1500 – 3100	27.8	16.7	22.2	11.1	11.1	11.1
3100 – 5400	31.4	22.9	17.1	11.4	8.6	8.6
5400 – 6100	32.3	12.9	22.6	12.9	9.7	9.7
6100 – 6400	34.4	12.5	18.8	12.5	9.4	12.5
6400 – 6700	30.3	12.1	18.2	12.1	15.2	12.1
6700 – 7700	30.3	12.1	18.2	12.1	15.2	12.1
7700 – 8400	27.8	11.1	19.4	13.9	13.9	13.9
8400 – 9000	28.6	11.4	20.0	11.4	14.3	14.3
9000 – 9400	28.6	11.4	20.0	11.4	14.3	14.3
9400 – 10000	25.6	12.8	20.5	10.3	12.8	17.9
10000 – 11000	25.7	11.4	20.0	11.4	14.3	17.1
11000 – 12700	17.0	28.3	13.2	17.0	9.4	15.1
12700 – 15800	20.3	18.9	10.8	25.7	10.8	13.5

Table A4. First molars (M1) measurements of *Sigmodon hispidus* from the Museum of Southwestern Biology (MSB), University of New Mexico. Mean lengths of upper left (ULM1), upper right (URM1), lower left (LLM1) and lower right (LRM1) first molars are given with standard error (SE), as well as weight as it was recorded on the specimen tag are given. Measurements were taken using a AM4515ZT Dino-Lite Edge.

MSB ID	Weight (g)	ULM1 ± SE	URM1 ± SE	LLM1 ± SE	LRM1 ± SE
57610	157.0	2.26 ± 0.00	2.17 ± 0.01	2.47 ± 0.01	2.49 ± 0.00
57611	156.0	2.33 ± 0.01	2.22 ± 0.01	2.43 ± 0.02	2.54 ± 0.00
57612	150.0	2.31 ± 0.01	2.27 ± 0.00	2.53 ± 0.01	2.56 ± 0.01
57613	134.0	2.22 ± 0.00	2.3 ± 0.00	2.34 ± 0.01	2.34 ± 0.01
57615	187.0	2.16 ± 0.00	2.22 ± 0.01	2.4 ± 0.01	2.45 ± 0.01
57616	206.0	2.22 ± 0.02	2.21 ± 0.01	2.64 ± 0.01	2.61 ± 0.01
57617	142.5	2.25 ± 0.00	2.32 ± 0.00	2.52 ± 0.01	2.52 ± 0.01
57618	125.0	2.25 ± 0.01	2.22 ± 0.02	2.56 ± 0.00	2.56 ± 0.01
57619	118.0	2.32 ± 0.01	2.24 ± 0.01	2.44 ± 0.00	2.44 ± 0.01
57622	44.1	2.11 ± 0.01	2.14 ± 0.01	2.28 ± 0.01	2.33 ± 0.01
57624	160.0	2.23 ± 0.01	2.28 ± 0.01	2.55 ± 0.00	2.65 ± 0.00
88977	59.7	1.92 ± 0.00	1.96 ± 0.00	2.16 ± 0.01	2.22 ± 0.01
104054	99.7	2.18 ± 0.01	2.14 ± 0.01	2.41 ± 0.00	2.39 ± 0.00
104055	87.8	2.4 ± 0.01	2.48 ± 0.01	2.65 ± 0.00	2.69 ± 0.01
104056	96.5	2.00 ± 0.00	2.08 ± 0.01	2.35 ± 0.00	2.35 ± 0.00
140853	106.0	1.98 ± 0.02	1.89 ± 0.00	2.08 ± 0.01	2.13 ± 0.01
180617	73.5	2.29 ± 0.00	2.18 ± 0.01	2.45 ± 0.00	2.41 ± 0.00
180618	81.0	2.15 ± 0.00	2.14 ± 0.01	2.31 ± 0.01	2.34 ± 0.00
180619	47.0	2.17 ± 0.01	2.16 ± 0.01	2.25 ± 0.01	2.30 ± 0.01
180895	88.9	2.18 ± 0.01	2.23 ± 0.01	2.51 ± 0.01	2.60 ± 0.01

Table A5. Results of Tukey honest significant differences on ANOVA ($p<0.001$, df=13/252) of $\delta^{15}N$ across all time interval. Only significant differences shown. Significance given as follow: *=$p<0.05$, **=$p<0.01$, ***=$p<0.001$.

Upper age range (cal BP)	Lower age range (cal BP)	Difference of means	p-value
12700 – 15800	1500 - 3100	1.23	**
11000 - 12700	5400 – 6100	1.57	*
11000 - 12700	1500 - 3100	1.85	**
10000 - 11000	5400 – 6100	1.14	**
10000 - 11000	1500 - 3100	1.42	***
9400 - 10000	1500 - 3100	1.37	**
8400 - 9000	6100 – 6400	1.02	**
8400 - 9000	5400 – 6100	1.22	**
8400 - 9000	1500 - 3100	1.50	***
8400 - 9000	0 - 1500	1.24	*
7700 - 8400	6700 - 7700	1.16	**
7700 - 8400	6100 – 6400	1.42	***
7700 - 8400	5400 – 6100	1.62	***
7700 - 8400	1500 - 3100	1.90	***
7700 - 8400	0 - 1500	1.65	**

Table A6. Fit linear model results for $\delta^{13}C$ and $\delta^{15}N$ for each age interval. Significance denoted under p-value as follows: ns=not significant, *=p<0.05, **=p<0.01, ***=p<0.001.

Age range (cal BP)	Adjusted R^2	p-value
0 – 1500	0.04	*ns*
1500 – 3100	-0.04	*ns*
3100 – 5400	0.28	*
5400 – 6100	0.08	*ns*
6100 – 6400	0.27	**
6400 – 6700	-0.14	*ns*
6700 – 7700	0.23	*
7700 – 8400	-0.05	*ns*
8400 – 9000	0.38	***
9000 – 9400	0.04	*ns*
9400 – 10000	0.21	*
10000 – 11000	0.40	***
11000 – 12700	-0.11	*ns*
12700 – 15800	0.11	*

Table A7. Outputs for 3 state-space model outputs for mass (Y_{mass}), $\delta^{13}C$ (Y_{carbon}) and $\delta^{15}N$ ($Y_{nitrogen}$) showing regression weight (β) values, with corresponding standard deviations (SD). All standard errors were < 0.05.

		Y_{mass}	SD_{mass}	Y_{carbon}	SD_{carbon}	$Y_{nitrogen}$	$SD_{nitrogen}$
Main variables							
body size	β_1	~	~	0.0	0.0	0.0	0.00
$\delta^{13}C$	β_2	1.7	0.5	~	~	0.2	0.00
$\delta^{15}N$	β_3	1.0	1.2	1.2	0.2	~	~
Climate variables							
mean precipitation	β_4	0.0	0.1	0.0	0.0	0.0	0.0
maximum temperature	β_5	0.9	1.9	-0.1	1.1	-0.8	0.8
minimum temperature	β_6	0.6	2.0	0.2	1.7	0.6	1.4
Community variables							
α-diversity	β_7	-0.3	1.1	-0.3	1.0	0.0	0.9
β-diversity	β_8	0.1	1.9	0.4	2.0	-0.6	2.0
% browsers	β_9	-0.4	1.8	0.2	1.0	0.0	0.8
% carnivores	β_{10}	0.3	1.3	-0.2	0.8	0.0	0.7
% frugivores/granivores	β_{11}	0.4	1.8	0.5	0.9	-0.4	0.8
% grazers	β_{12}	-0.9	1.7	0.5	1.0	-0.1	0.8
% insectivores	β_{13}	-0.6	1.9	-0.8	1.1	0.3	0.8
% omnivores	β_{14}	0.7	1.9	-0.3	1.1	0.2	0.8

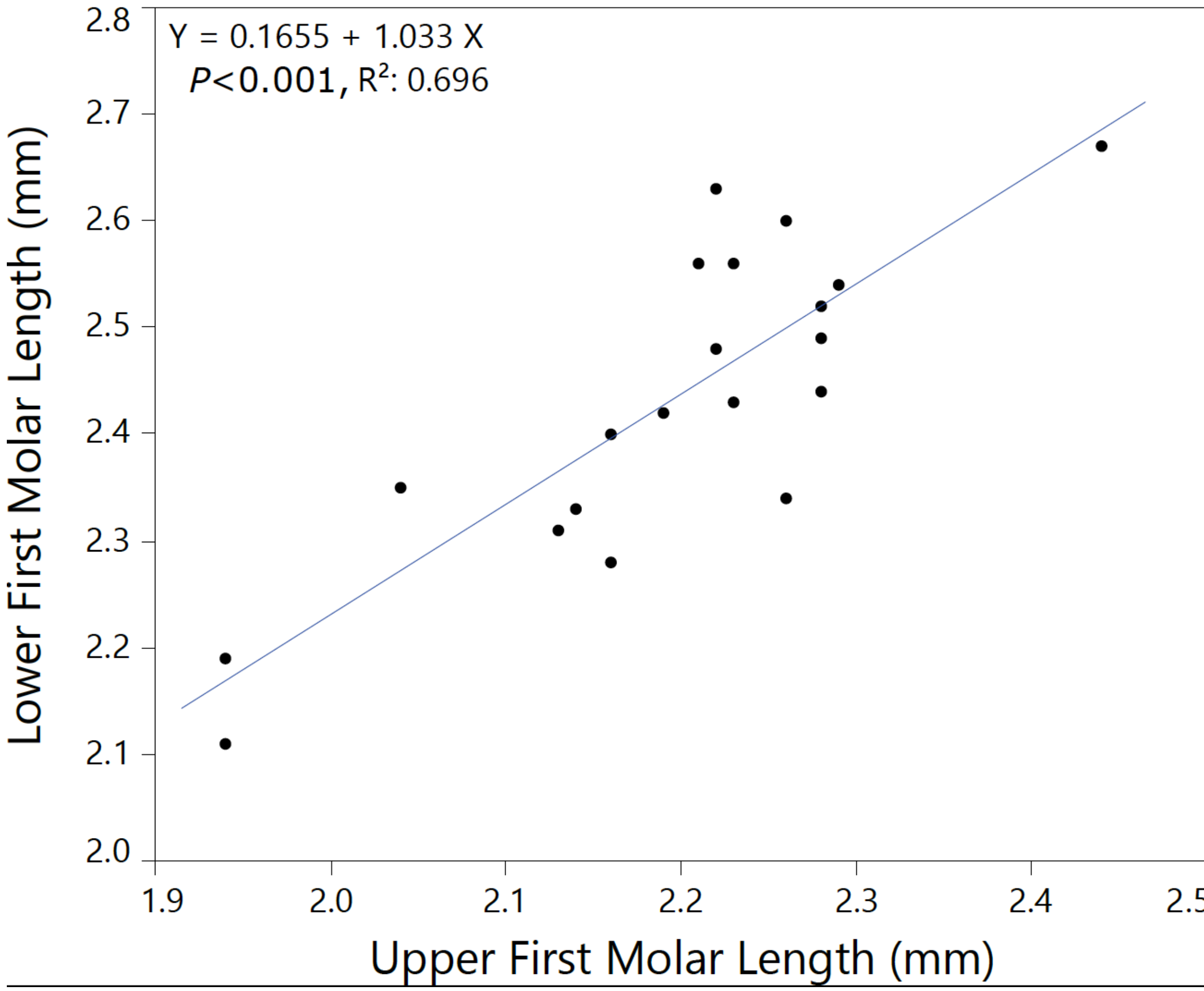

Figure A2. Upper and lower first molar relationship. Linear fit of upper and lower first molar length (mm) of *Sigmodon hispidus.* Note: sample size is low (n=20), with R^2 = 0.7 and adjusted R^2 = 0.68.

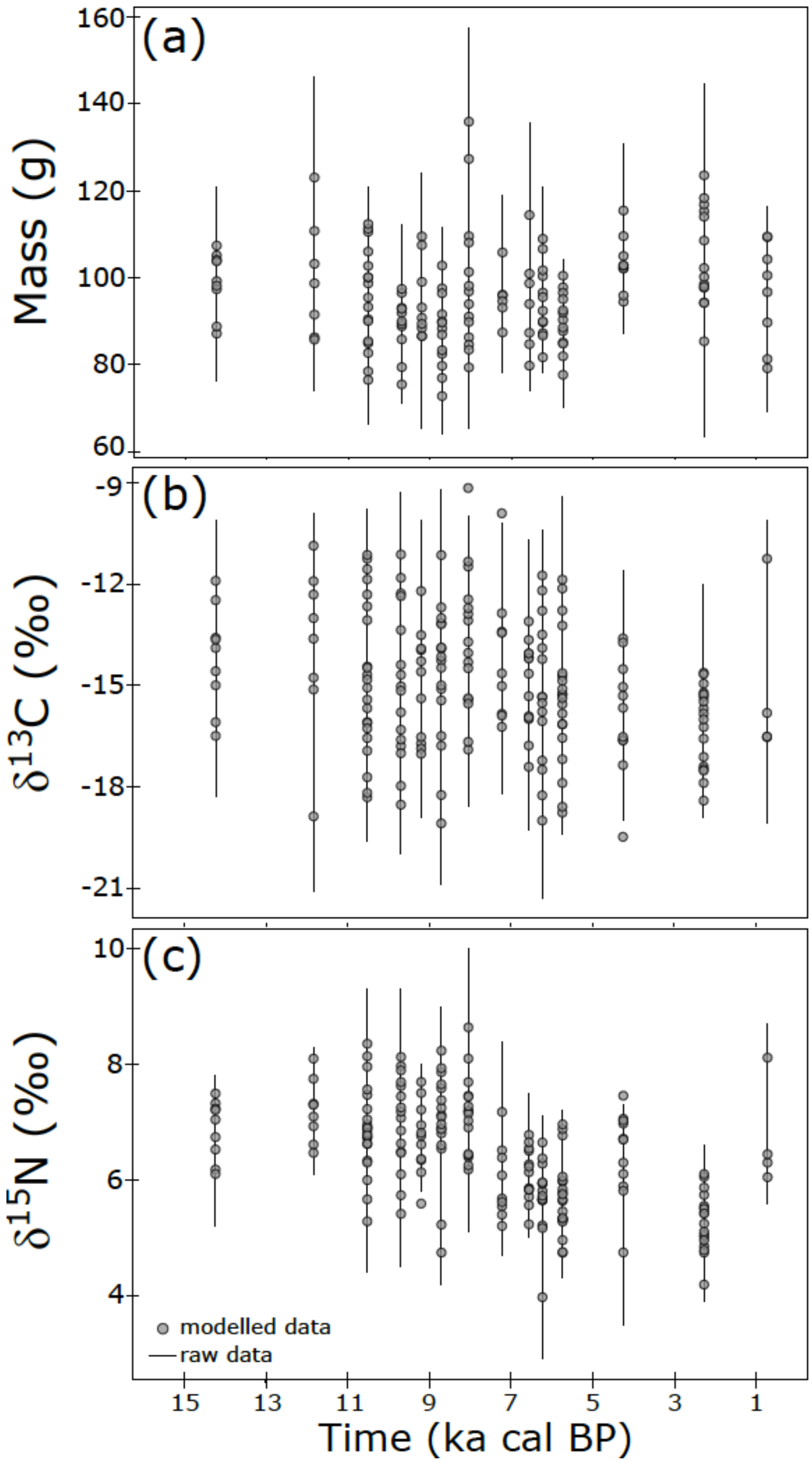

Figure A3. State-space models. Results of state space models showing the fit of modelled responses for a) mass, b) $\delta^{13}C$, c) $\delta^{15}N$. Black lines represent the range of raw data values. Grey circles are the output data from each model.

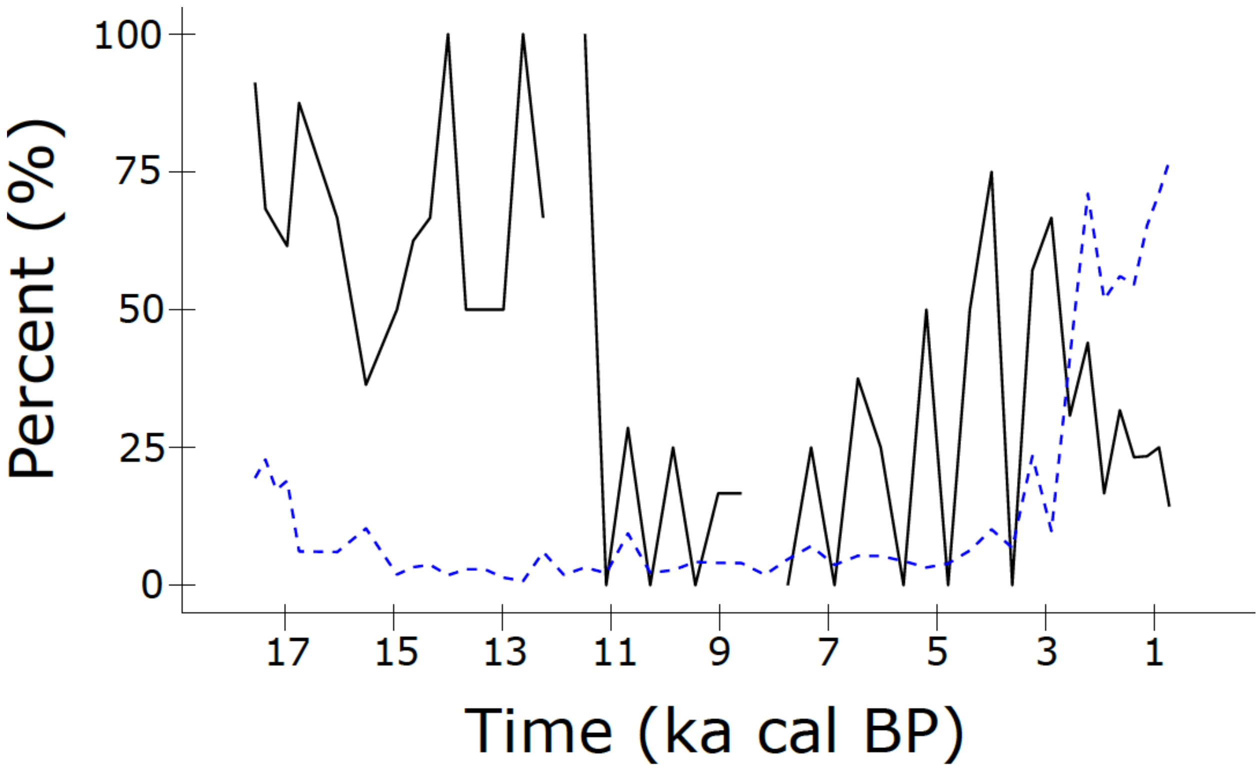

Figure A4. C_3 versus C_4 grasses at Hall's Cave over time. Plant fossil data from Cordova and Johnson 2019 showing the ratio of C_3 to C_4 grasses as a percent (solid line) and the proportion of grass out of all phytolith fossils (dashed blue line) present in the Hall's Cave record over 17000 years (cal BP).