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SUPPLEMENTARY ONLINE MATERIAL FOR

Body mass estimation in Triassic cynodonts from Argentina based on limb variables

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Supplementary Online Material

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available at http://app.pan.pl/SOM/app67-Filippini_etal_SOM/SOM_2.xlsx.

Table S1. Simple Regression selected functions, associated statistics and sources using humeri and femora variables for body mass estimation. Abbreviations: **APDF**, antero-posterior diameter of femur (at midshaft); **APDH**, antero-posterior diameter of humerus (at midshaft); **FC**, femur circumference; **FL**, femoral length (between head and medial condyle); **HC**, humerus circumference; **HL**, humerus length (between head and trochlea); R^2, coefficient of determination; **TDH**, transverse diameter of humerus (at midshaft); **TDF**, transverse diameter of femur (at midshaft); **%PE**, percent prediction error. *Value obtained by calculating an average among all the PE%. **Regressions calculated using Campione and Evans (2012) data set.

Variable	Slope	Intercept	R^2	%PE	Base data group	Body mass range	Source
Humerus							
HL	3.4026	-2.3707	0.9209	28	Ungulata	5 kg to 820 kg	Scott 1990
HL	3.3951	-2.513	0.9196	29			
TDH	2.485	1.0934	0.9546	20			
APDH	2.4937	0.876	0.9438	21			
HL	2.93	-5.11	0.94	30	Carnivora	5 kg to 500 kg	Anyonge 1993
HL	1.64	-2.38	0.89	21	Canidae	6 kg to 46 kg	
APDH	2.484	-1.467	0.970	20.25	Caviomorpha	49.9 kg to 0.290 kg	Biknevicius *et al.* 1993
HL	3.366	-6.215	0.978	22.43	Carnivora	1.45 kg to 290 kg	Figuerido *et al.* 2011
TDH	2.447	-1.430	0.987	19.41			
APDH	2.502	-1.674	0.988	18.13			
HL	2.802	- 1.716	0.95	50.658	Mammalia; Non-avian Reptilia	0.05 kg to 6435 kg	Campione and Evans 2012
HC	2.651	- 0.089	0.986	26.922			
HL	2.797	-1.725	0.9548	50.601	Mammalia	0.05 kg to 6435 kg	This Work**
HC	2.670	-0.132	0.9823	27.731			
HL	3.202	-2.274	0.9018	45.301	Non-avian Reptilia	0.07 kg to 167.83 kg	
HC	2.715	-0.129	0.9634	27.381			
Femur							
FL	3.4855	- 2.9112	0.9241	28	Ungulata	5 kg to 820 kg	Scott 1990
TDF	2.821	0.9062	0.9402	23			
APDF	2.6016	0.9119	0.9373	26			
FL	2.92	- 5.27	0.95	25	Carnivora	5 kg to 500 kg	Anyonge 1993
FL	1.67	-2.54	0.88	20	Canidae	6 kg to 46 kg	
APDF	2.518	-1.678	0.964	22.37	Caviomorpha	49.9 kg to 0.290 kg	Biknevicius *et al.* 1993
FL	3.33	-5.72	0.994	30.76*	Alligatoridae	1 kg to 304.2 kg	Farlow 2005
FL	3.173	-5.901	0.979	21.28	Carnivora	1.45 kg to	Figuerido *et al.*

TDF	2.659	-1.749	0.994	14.06		290 kg	2011
APDF	2.708	-1.682	0.988	20.66			
FL	2.843	-2.005	0.93	70.822	Mammalia; Non-avian Reptilia	0.05 kg to 6435 kg	Campione and Evans 2012
FC	2.818	-0.417	0.979	33.934			
FL	2.908	-2.174	0.9439	66.767	Mammalia	0.05 kg to 6435 kg	This work**
FC	2.874	-0.527	0.9834	31.158			
FL	2.866	-1.853	0.7778	59.904	Non-avian Reptilia	0.07 kg to 167.83 kg	
FC	2.729	-0.192	0.954	29.106			

Table S2. Multiple regression functions and associated statistics for weight estimation using measurements of the humerus and femur. Abbreviations: **APDF**, antero-posterior diameter of femur (at midshaft); **APDH**, antero-posterior diameter of humerus (at midshaft); **FC**, femur circumference; **FCW**, femoral maximum condylar width; **FHL**, femoral head length; **FL**, femoral length (between head and medial condyle); **HC**, humerus circumference; **HDASW**, humerus distal articular surface width; **HEMP**, humeral entepicondyle medial protrusion; **HL**, humerus length (between head and trochlea); **HTVL**, humeral trochlear valley length; **MCL**, medial condyle length; **PGW**, patellar groove width; R^2, coefficient of determination; **TDF**, transverse diameter of femur (at midshaft); **TDH**, transverse diameter of humerus (at midshaft); **Wtroc**, width across trochanters; **%PE**, percent prediction error.

Equation	R^2	%PE	Base data group	Body mass range	Source
Humerus			Xenarthra, Marsupialia, Pholidota, Tubulidentata, Carnivora, Primates and Rodentia	0.275kg to 190.768kg	Toledo *et al.* 2014
-1.971 + -0.925 x TDH + 1.993 x APDH + 0.553 x HDASW + 0.599 x HTVL + 0.5127 x HEMP	0.970	9.263			
Femur					
-1.116 + -1.437 x TDF + 1.026 x WTroc + -1.026 x FL + 1.2154 x FHL + -1.505 x FCW + 2.388 x MCL + 1.762 x PGW	0.968	7.833			
Phylogenetic Generalised Least Squares Regression (Humerus + Femur)					
2.754 x log(HC+FC) – 1.097	-	25.03	Mammalia and Non-avian Reptilia	0.05 kg to 6435 kg	Campione and Evans 2012
0.212 x logHL + 1.347 x logHC – 0.533 x logFL + 0.749 x logFC -0.76	-	26.326			

1.54 x logHC + 1.195 x logFC – 0.234	-	24.624			

Table S3. Humerus measurements (in mm) for specimens of Cynognathia studied.

Measurements abbreviations: **HL**, humerus length (between head and trochlea); **TDH**, transverse diameter of humerus (at midshaft); **APDH**, antero-posterior diameter of humerus (at midshaft); **HDASW**, humerus distal articular surface width; **HTVL**, humeral trochlear valley length; **HEMP**, humeral entepicondyle medial protrusion; **HC**, humerus circumference.

Taxa	Specimen	HL	TDH	APDH	HDASW	HTVL	HEMP	HC
Andescynodon mendozensis	PVL 3890	35.86	4.80	4.04				18.24
	PVL 3894-1	32.20	3.27	3.87	10.56	3.01	6.09	13.74
	PVL 4424	40.50	4.87	4.31				18.39
	PVL 4425	36.21	3.76	4.59				15.06
	PVL 4426	45.83	4.77	5.26	12.88	4.65	6.95	16.49
	PVL 4427	49.89	4.89	4.45	13.97	4.38	5.88	20.55
Cynognathus crateronotus	PVL 3859	134.8	13.64	12.39	33.51	13.12	12.32	45.64
Exaeretodon argentinus	PVL 2467	178.51	26.01	22.13	50.61	20.32	34.14	100.3
	PVL 2554	178.33	22.98	27.22	68.07	23.09	33.68	97.54
Massetognathus pascuali	PVL 4613	50.18	4.64	5.51	15.54	6.11	6.98	19.66
	PVL 5444	54.07	6.10	5.09	14.34	7.45	5.87	18.13
Pascualgnathus polanskii	MLP 65-VI-18-1	65	7.06	7.57	21.22	4.18	11.82	26.95

Table S4. Femur measurements (in mm) for specimens of Cynognathia studied.

Measurements abbreviations: **FL**, femoral length (between head and medial condyle); **TDF**, transverse diameter of femur (at midshaft); **APDF**, antero-posterior diameter of femur (at

midshaft); **Wtroc**, width across trochanters; **FHL**, femoral head length; **FCW**, femoral maximum condylar width; **MCL**, medial condyle length; **PGW**, patellar groove width; **FC**, femur circumference.

Taxa	Specimen	FL	TDF	APDF	Wtroc	FHL	FCW	MCL	PGW	FC
Andescynodon mendozensis	PVL 3890	50.86	5.94	6.88	20.69	6.33	14.88	5.34	5.26	20.33
	PVL 3894-1	42.17	3.60	4.30	11.93	8.03	10.34	4.86	4.65	13.35
Exaeretodon argentinus	PVL 2554	198.03	28.7	19.38	77.02	43.73	65.11	26.1	22.82	76.98
	PVL 2565	105.11	15.13	10.26	38.95	18.45	36.9	9.14	12.13	42.09
Massetognathus pascuali	PVL 5444	57.18	5.25	5.16	12.38	8.69	14.63	6.82	5.71	18.13
	PVL 5445	85.33	7.49	8.93	22.9	15.47	26.74	15.68	11.97	27.02
Pascualgnathus polanskii	MLP 65-VI-18-1	63.71	5.87	7.73	19.61	9.46	15.4	11.14	6.21	21.80

Table S5. Measurements names/acronyms equivalency between different author's variables.

Toledo *et al.* 2014	Scott 1990	Anyonge 1993	Biknevicius *et al.* 1993	Figuerido *et. al.* 2011
HL	H1,H2	HL	-	HTL
TDH	H7	-	-	Hdml
APDH	H8	-	APD	Hdap
FL	F1	FL	-	FTL
TDF	F6	-	-	Fdml
APDF	F7	-	APD	Fdap

Table S6. Body mass estimations (kg) from each regression equation obtained with humerus measurements for specimens of Cynognathia studied.

Regression equations		***Andescynodon mendozensis***						***Cynognathus crateronotus***	***Exaeretodon argentinus***		***Massetognathus pascuali***		***Pascualgnathus polanskii***
Measurements	**Source**	**PVL 3890**	**PVL 3894-1**	**PVL 4424**	**PVL 4425**	**PVL 4426**	**PVL 4427**	**PVL 3859**	**PVL 2467**	**PVL 2554**	**PVL 4613**	**PVL 5444**	**MLP 65-VI-18-1**
HL	Scott 1990	0.33	0.23	0.50	0.42	0.76	1.01	29.73	77.30	77.04	1.03	1.33	2.48
HL	Scott 1990	0.23	0.16	0.35	0.24	0.54	0.72	21.01	54.52	54.33	0.73	0.95	1.77
TDH	Scott 1990	2.00	0.77	2.07	1.09	1.97	2.10	26.82	133.36	98.03	1.84	3.63	5.22
TDH	Scott 1990	0.78	0.70	0.92	1.08	1.51	1.00	12.83	54.49	91.30	1.70	1.40	3.75
HL	Anyonge 1993	0.28	0.20	0.40	0.29	0.57	0.73	13.49	30.72	30.63	0.75	0.93	1.59
HL	Anyonge 1993	1.48	1.24	1.80	1.50	2.21	2.54	12.96	20.55	20.51	2.56	2.90	3.92
APDH	Biknevicius *et al.* 1993	1.09	0.98	1.29	1.50	2.11	1.39	17.71	74.81	125.10	2.37	1.94	5.21
HL	Figuerido *et al*. 2011	0.10	0.07	0.16	0.11	0.24	0.32	8.99	23.13	23.05	0.32	0.42	0.77
TDH	Figuerido *et al*. 2011	1.73	0.67	1.79	0.95	1.70	1.81	22.23	107.86	79.66	1.59	3.10	4.44
APDH	Figuerido *et al*. 2011	0.70	0.63	0.82	0.96	1.35	0.89	11.50	49.11	82.43	1.51	1.24	3.35
HL	Campione & Evans	0.44	0.32	0.61	0.45	0.87	1.10	17.84	39.19	39.08	1.12	1.38	2.31

	2012												
HC	Campione & Evans 2012	2.39	1.09	2.44	1.41	1.81	3.31	29.69	258.57	239.48	2.93	2.35	6.98
Humerus multiple regression from Table 4.	Toledo *et al.* 2014	-	0.84	-	-	2.71	2.67	24.91	66.74	63.32	2.64	2.03	1.26
HL	This work	0.42	0.31	0.59	0.43	0.83	1.06	17.05	37.40	37.30	1.07	1.32	2.22
HC	This work	1.72	0.81	1.76	1.03	1.31	2.36	19.88	162.73	151.05	2.10	1.69	4.87
HL	This work	0.51	0.36	0.75	0.52	1.11	1.46	35.10	86.26	85.98	1.48	1.88	3.40
HC	This work	1.97	0.91	2.02	1.17	1.50	2.72	23.78	201.62	186.91	2.42	1.94	5.69

Table S7. Body mass estimations (kg) from each regression equation obtained with femur measurements for specimens of Cynognathia studied.

Regression equations		***Andescynodon mendozensis***		***Exaeretodon argentinus***		***Massetognathus pascuali***		***Pascualgnathus polanskii***
Measurements	**Source**	**PVL 3890**	**PVL 3894-1**	**PVL 2554**	**PVL 2565**	**PVL 5444**	**PVL 5445**	**MLP 65-VI-18-1**

FL	Scott 1990	0.36	0.19	40.60	4.46	0.53	2.16	0.78
TDF	Scott 1990	1.85	0.45	157.72	25.91	1.31	3.57	1.79
APDF	Scott 1990	3.09	0.91	45.65	8.73	1.46	6.08	4.18
FL	Anyonge 1993	0.52	0.30	27.32	4.30	0.73	2.34	1.00
FL	Anyonge 1993	2.04	1.49	19.75	6.86	2.48	4.84	2.97
APDF	Biknevicius *et al.* 1993	2.70	0.83	36.61	7.38	1.31	5.20	3.62
FL	Farlow *et al.* 2005	0.92	0.49	84.75	9.36	1.35	5.14	1.94
FL	Figuerido *et al.* 2011	0.33	0.18	24.35	3.26	0.47	1.68	0.67
TDF	Figuerido *et al.* 2011	2.03	0.54	134.12	24.45	1.47	3.77	1.97
APDF	Figuerido *et al.* 2011	3.86	1.08	63.70	11.38	1.77	7.81	5.29
FL	Campione & Evans 2012	1.16	0.69	52.41	8.88	1.61	4.95	2.18
FC	Campione & Evans 2012	1.86	0.57	79.22	14.45	1.35	4.14	2.26
Femur multiple regression from Table 4.	Toledo *et al.* 2014	0.39	0.81	25.66	1.35	0.76	12.39	3.55
FL	This work	0.61	0.36	31.98	5.07	0.86	2.76	1.18

FC	This work	1.71	0.51	78.42	13.83	1.23	3.87	2.09
FL	This work	1.09	0.64	53.63	8.73	1.52	4.80	2.08
FC	This work	2.39	0.76	90.35	17.39	1.75	5.19	2.89

Table S8. Body mass estimations (kg) from each multiple regression equation from Campione & Evans (2012) for specimens of Cynognathia which have both humerus and femur preserved.

Phylogenetic GLS Regression (Humerus + Femur)	***Andescynodon mendozensis***		***Exaeretodon argentinus***	***Massetognathus pascuali***	***Pascualgnathus polanskii***
	PVL 3890	**PVL 3894-1**	**PVL 2554**	**PVL 5444**	**MLP 65-VI-18-1**
Regression (1)	1.87	0.71	119.41	1.58	3.56
Regression (2)	0.022	0.012	0.385	0.020	0.039
Regression (3)	1.87	0.73	121.22	1.61	3.70

Table S9. Predictive power of stylopodial ordinary least square (OLS) body mass estimation equations based on Campione & Evans's (2012) data set.

Group	**OLS regression**	**n**	**BM range g**	**PPE**	**PPE CI**	**R2**	**F num den df**	**p-value**	**AIC**
mammals	-1.725 + log10(HL)*2.797	187	53 - 6435000	50.601	43.296 - 57.906	0.9548	3908.112(1;185)	2.4E-126	40.30
mammals	-0.132 + log10(HC)*2.67	200	53 - 6435000	27.731	23.828 - 31.633	0.9823	10957.454(1;198)	2.7E-175	-137.61
mammals	-2.174 + log10(FL)*2.908	188	53 - 6435000	66.767	44.967 - 88.566	0.9439	3129.05(1;186)	2.7E-118	80,61
mammals	-0.527 + log10(FC)*2.87	200	53 - 6435000	31.158	26.313 - 36.003	0.9834	11747.217(1;198)	3E-178	-151.29
NonAvian Reptiles	-2.274 + log10(HL)*3.202	47	79 - 167830	45,301	35.392 - 55.209	0.9018	413.141(1;45)	2.63E-24	0.20
NonAvian Reptiles	-0.129 + log10(HC)*2.715	47	79 - 167830	27.381	21.133 - 33.629	0.9634	1183.474(1;45)	5.85E-34	-46.16
NonAvian Reptiles	-1.853 + log10(FL)*2.866	46	79 - 72000	59.904	48.015 - 71.793	0.7778	154.041(1;44)	5.71E-16	27.06
NonAvian Reptiles	-0.192 + log10(FC)*2.729	47	79 - 167830	29.106	22.114 - 36.099	0.9540	932.39(1;45)	1.01E-31	-35.42