

Morphology of the maxilla reveals the type of predation strategy in the evolution of the Abelisauridae (Dinosauria: Theropoda)

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Supplementary material

Supplementary table 1: Literature used to perform the morphometric analysis on the maxilla.

Species	Reference
<i>Aucasaurus</i>	Matias Baiano thesis 2021 ¹
<i>Abelisaurus</i>	Matias Baiano thesis 2021 ¹
<i>Allosaurus</i>	Emily J. Rayfield <i>et al</i> 2001 ²
<i>Carnotaurus</i>	M.A. Cerroni , J. I. Canale & F. E. Novas 2020 ³
<i>Ceratosaurus</i>	Scott D. Sampson & Lawrence M. Witmer 2007 ⁴
<i>Dilophosaurus</i>	Adam D. Marsh and Timothy B. Rowe 2020 ⁵
<i>Herrerasaurus</i>	Paul C. Sereno & Fernando E. Novas ⁶
<i>Majungasaurus</i>	Scott D. Sampson & Lawrence M. Witmer 2007 ⁴
<i>Masiakasaurus</i>	Rafael Delcourt 2018 ⁷
<i>Rugops</i>	Paul C. Sereno, Jeffrey A. Wilson and Jack L. Conrad 2004 ⁸
<i>Skorpiovenator</i>	Juan I. Canale, Carlos A. Scanferla, Federico L. Agnolin & Fernando E. Novas 2009 ⁹
<i>Spectrovenator</i>	Hussam Zaher, Diego Pol, Bruno A. Navarro, Rafael Delcourt and Alberto B. Carvalho 2020 ¹⁰
<i>Ekrixinatosaurus</i>	Matias Baiano thesis 2021 ¹
<i>Llukalkan</i>	Federico A. Gianechini, Ariel H. Méndez, Leonardo S. Filippi, Ariana Paulina-Carabajal, Rubén D. Juárez-Valieri & Alberto C. Garrido 2021 ¹¹
<i>Syntarsus</i>	Timothy Rowe 1989 ¹²
<i>Limusaurus</i>	Xing Xu <i>et al</i> 2009 ¹³
<i>Noasaurus</i>	Rafael Delcourt 2018 ⁷

Supplementary table 2: Anatomical landmarks description of each landmark in Figure

4 B. * Denote semilandmarks

Landmarks	Anatomical description
1	Dorsal margin of the maxillary border at the posterior limit of the external contour of the maxilla
2	Ventral margin of the maxilla directly beneath landmark 1
3	Antero-ventral corner of the maxillary body
4	Anterior maxillary margin in front of point 1
5	Dorsal margin of the external maxillary surface at anterior limit of jugal contact
6	Postero-ventral corner of the maxilla at the jugal contact surface
7-10*	Anterior maxillary border between landmark 3 and 4
11-15*	Ventral maxillary border between landmark 2 and 6
16-19*	Dorsal margin of maxillary border between landmark 1 and 5

Supplementary table 3: Phylogenetic generalized least square in Procrustes coordinates, 90% Phylo PCA and 90% PACA in Prior and Posterior hypothesis. Variables: TPS (Type of predation strategy: Specialist hunters and Generalist hunters), Size of maxilla and the interaction between the TPS and size (TPS*Size). DF: freedom degrees, SS: sum of square. R²: Variance explained by the factor in data. Z: effect of size. In bold significant effects (p-value <0.05).

Variables	Data	Prior hypothesis				Posterior hypothesis			
		Df	SS	R ²	Z	Df	SS	R ²	Z
Size	PC	1	0.001	0.03	-0.48	1	0.002	0.06	0.39
TPS		1	0.001	0.06	0.15	1	0.001	0.05	0.13
TPS*Size		1	0.004	0.14	1.57	1	0.003	0.14	1.68
Residuals		13	0.020			13	0.019	0.75	
		DF	SS	R ²	Z	Df	SS	R ²	Z
Size	Phylo PCA	1	0.013	0.03	0.11	1	0.013	0.03	0.29
TPS		1	0.212	0.43	3.07	1	0.234	0.47	3.32
TPS*Size		1	0.051	0.10	1.64	1	0.052	0.10	1.77
Residuals		13	0.199	0.40		13	0.177	0.36	
		Df	SS	R ²	Z	Df	SS	R ²	Z
Size	PACA	1	0.010	0.02	0.06	1	0.011	0.02	0.19
TPS		1	0.190	0.43	2.90	1	0.199	0.45	3.07
TPS*Size		1	0.045	0.10	1.57	1	0.049	0.11	1.74
Residuals		13	0.176	0.40		13	0.163	0.37	

Supplementary table 4: Estimated evolution rate matrix of the best model for specialist and generalist hunter in 90 % Phylogenetic PCs in “All taxa clade” analysis.

Specialist					
	Comp1	Comp2	Comp3	Comp4	Comp5
Comp1	6.06E-04	-4.10E-04	1.89E-05	-6.10E-05	1.87E-04
Comp2	-4.10E-04	4.61E-04	-6.65E-05	-3.68E-05	-2.39E-04
Comp3	1.89E-05	-6.65E-05	4.33E-05	2.56E-05	7.92E-05
Comp4	-6.10E-05	-3.68E-05	2.56E-05	6.69E-05	4.14E-05
Generalist					
	Comp1	Comp2	Comp3	Comp4	Comp5
Comp1	7.93E-04	-2.03E-05	1.60E-04	5.43E-05	9.27E-05
Comp2	-2.03E-05	4.10E-05	1.16E-05	-2.01E-05	-2.02E-06
Comp3	1.60E-04	1.16E-05	6.69E-05	4.79E-06	1.87E-05
Comp4	5.43E-05	-2.01E-05	4.79E-06	2.38E-05	-1.09E-05

Supplementary table 5: Estimated evolution rate matrix of the best model for specialist and generalist hunter in 90% Phylogenetic PCs in “Dilophosaurus clade” analysis.

Specialist				
	Comp1	Comp2	Comp3	Comp4
Comp1	6.68E-04	5.65E-05	7.58E-05	5.08E-06
Comp2	5.65E-05	3.37E-04	-4.12E-05	-2.71E-06
Comp3	7.58E-05	-4.12E-05	5.12E-05	-4.13E-06
Comp4	5.08E-06	-2.71E-06	-4.13E-06	2.56E-05
Generalist				
	Comp1	Comp2	Comp3	Comp4
Comp1	1.90E-04	-1.16E-04	-1.13E-04	-7.32E-06
Comp2	-1.16E-04	8.23E-05	7.39E-05	6.80E-06
Comp3	-1.13E-04	7.39E-05	7.56E-05	7.69E-06
Comp4	-7.32E-06	6.80E-06	7.69E-06	2.86E-05

Supplementary table 6: Estimated evolution rate matrix of the best model in removed-estimated taxa analysis for specialist and generalist hunter in 90 % Phylogenetic PCs in “All taxa clade”.

Specialist				
	Comp1	Comp2	Comp3	Comp4
Comp1	4.47E-04	-7.62E-05	-7.51E-05	2.58E-06
Comp2	-7.62E-05	3.33E-04	-3.68E-05	-2.95E-06
Comp3	-7.51E-05	-3.68E-05	3.24E-05	-5.22E-06
Comp4	2.58E-06	-2.95E-06	-5.22E-06	2.71E-05
Generalist				
	Comp1	Comp2	Comp3	Comp4
Comp1	2.83E-04	8.39E-05	1.11E-04	8.05E-07
Comp2	8.39E-05	3.92E-05	4.21E-05	6.44E-06
Comp3	1.11E-04	4.21E-05	5.32E-05	-6.01E-07
Comp4	8.05E-07	6.44E-06	-6.01E-07	2.30E-05

Supplementary table 7: Estimated evolution rate matrix of the best model in removed-estimated taxa analysis for specialist and generalist hunter in 90% Phylogenetic PCs in “Dilophosarus clade”.

Specialist				
	Comp1	Comp2	Comp3	Comp4
Comp1	5.06E-04	-9.75E-05	5.40E-05	-1.95E-06
Comp2	-9.75E-05	3.58E-04	1.70E-05	-1.62E-05
Comp3	5.40E-05	1.70E-05	1.74E-05	2.59E-06
Comp4	-1.95E-06	-1.62E-05	2.59E-06	2.50E-05
Generalist				
	Comp1	Comp2	Comp3	Comp4
Comp1	1.65E-04	7.01E-05	-1.02E-04	1.25E-05
Comp2	7.01E-05	4.01E-05	-5.05E-05	8.43E-06
Comp3	-1.02E-04	-5.05E-05	7.31E-05	-2.95E-06
Comp4	1.25E-05	8.43E-06	-2.95E-06	3.62E-05

Supplementary table 8: Confidence interval (IC) of 95% for the diagonal values of the evolution rate matrix in the best model for 90% of Phylo PCs in “All taxa clade” and “Dilophosaurus clade”. * Show that the value of the parameter is outside of the Confidence interval (IC).

	Phylo-PCs	Lower IC	Upper IC	Observed		Lower IC	Upper IC	Observed
All taxa clade	PC1_ESP	0.00020	0.00112	0.00061	Dilophosaurus clade	0.00021	0.00128	0.00067
	PC2_ESP	0.00014	0.00091	0.00046		0.00012	0.00082	0.00034
	PC3_ESP	0.00001	0.00010	0.00004		0.00002	0.00012	0.00005
	PC4_ESP	0.00002	0.00017	0.00007		0.00001	0.00007	0.00003
	PC1_GEN	0.00025	0.00138	0.00079		0.00004	0.00062	0.00019
	PC2_GEN	0.00001	0.00015	0.00004		0.00001	0.00026	0.00008
	PC3_GEN	0.00002	0.00012	0.00007		0.00002	0.00017	0.00008
	PC4_GEN	0.00001	0.00005	0.00002		0.00001	0.00009	0.00003

Supplementary table 9: Confidence interval (IC) of 95% for the diagonal values of the evolution rate matrix in the best model for 90% of Phylo PCs in estimated taxa-removal analysis for “All taxa clade” and “Dilophosaurus clade”. * Show that the value of the parameter is outside of the Confidence interval (IC).

	Phylo-PCs	Lower IC	Upper IC	Observed		Lower IC	Upper IC	Observed
All taxa clade	PC1_ESP	0.00011	0.00087	0.00045	Dilophosaurus clade	0.00013	0.00098	0.00051
	PC2_ESP	0.00008	0.00066	0.00033		0.00009	0.00073	0.00036
	PC3_ESP	0.00001	0.00007	0.00003		0.00001	0.00005	0.00002
	PC4_ESP	0.00001	0.00010	0.00003		0.00001	0.00009	0.00002
	PC1_GEN	0.00007	0.00055	0.00028		0.00004	0.00044	0.00016
	PC2_GEN	0.00001	0.00013	0.00004		0.00001	0.00020	0.00004
	PC3_GEN	0.00002	0.00012	0.00005		0.00002	0.00018	0.00007
	PC4_GEN	0.00001	0.00006	0.00002		0.00001	0.00013	0.00004

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