

Supporting Information

Zanno and Makovicky 10.1073/pnas.1011924108

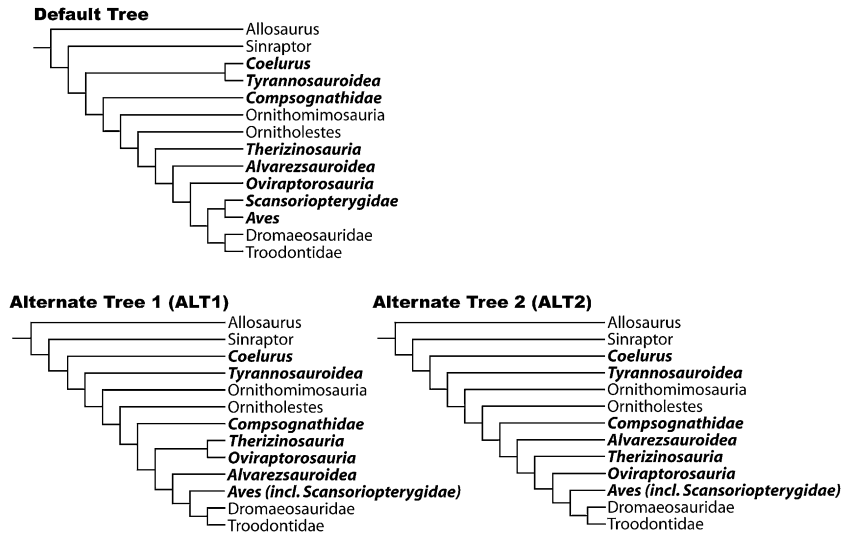


Fig. S1. Alternative tree topologies used to test phylogenetic uncertainty in the relationships between major coelurosaurian subclades in character correlation and ranked trait progression analyses. ALT1 and ALT2 represent the major topologies recovered by (40). The position or composition (Aves) of bold taxa varies between the three topologies. Please see [SI Appendix](#) for reference list.

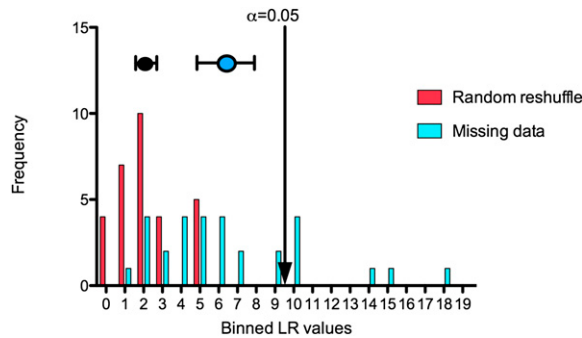


Fig. S2. Histogram summarizing the results of missing data sensitivity tests. Permutations were conducted on Discrete analyses testing for correlation between EEH and a subset of three CHTs. Blue bars represent reanalysis in which missing data for EEH is replaced with randomized data. Red bars represent replicates with all EEH entries randomized (control). Plot shows variation of means between fully random data (black circle) and randomly replaced missing data (blue circle) and the presence of significant LR values despite randomly replaced missing data. Simulations studies indicate that our results are robust and would be expected to withstand the addition of future discoveries, even if future discoveries do not fit the pattern detected here.

Table S1. Extrinsic evidence of diet

Taxon	Extrinsic evidence of diet									Ref./specimen no.
	1	2	3	4	5	6	7	8	9	
<i>Allosaurus fragilis</i>	?	?	?	1	1	?	?	1	0	(50, 51)
<i>Sinraptor dongi</i>	?	?	?	?	?	?	?	?	?	
<i>Dilong paradoxus</i>	?	?	?	?	?	?	?	?	?	
<i>Eotyrannus lengi</i>	?	?	?	?	?	?	?	?	?	
<i>Tyrannosaurus rex</i>	?	?	?	1	?	1	?	1	0	(52–54)
<i>Gorgosaurus libratus</i>	?	0	?	1	?	?	?	1	0	(55)
<i>Tanycolagreus topwilsoni</i>	?	?	?	?	?	?	?	?	?	
<i>Coelurus fragilis</i>	?	?	?	?	?	?	?	?	?	
<i>Ornitholestes hermanni</i>	?	?	?	?	?	?	?	?	?	
<i>Compsognathus longipes</i>	?	0	?	?	?	?	1	1	0	(56)
<i>Huaxiagnathus orientalis</i>	?	0	?	?	?	?	?	?	?	CAGS-IG02-301; (57)
<i>Sinosauropteryx prima</i>	?	0	?	?	?	?	1	1	0	(58–60)
<i>Anserimimus planinychus</i>	?	?	?	?	?	?	?	?	?	
<i>Harpymimus okladnikovii</i>	?	?	?	?	?	?	?	?	?	
<i>Pelecanimimus polyodon</i>	?	?	?	?	?	?	?	?	?	
<i>Archaeornithomimus asiaticus</i>	?	?	?	?	?	?	?	?	?	
<i>Gallimimus bullatus</i>	?	?	?	?	?	?	?	?	?	
<i>Ornithomimus edmontonicus</i>	?	0	?	?	?	?	?	?	?	RTMP 95.110.1; (61)
<i>Garudimimus brevipes</i>	?	?	?	?	?	?	?	?	?	
<i>Struthiomimus altus</i>	?	0	?	?	?	?	?	?	?	AMNH 5339; (62)
<i>Shenzhousaurus orientalis</i>	?	1	1	?	?	?	?	?	1	(46)
<i>Sinornithomimus dongi</i>	?	1	1	?	?	?	?	?	1	(63)
<i>Falcarius utahensis</i>	?	?	?	?	?	?	?	?	?	
<i>Beipiaosaurus inexpectus</i>	?	?	?	?	?	?	?	?	?	
<i>Alxasaurus elesitaiensis</i>	?	?	?	?	?	?	?	?	?	
<i>Nothronychus mckinleyi</i>	?	?	?	?	?	?	?	?	?	
<i>Erliaosaurus bellamanus</i>	?	?	?	?	?	?	?	?	?	
<i>Nanshiungosaurus brevispinus</i>	?	?	?	?	?	?	?	?	?	
<i>Neimongosaurus yangi</i>	?	?	?	?	?	?	?	?	?	
<i>Segnosaurus galbiensis</i>	?	?	?	?	?	?	?	?	?	
<i>Erlikosaurus andrewsi</i>	?	?	?	?	?	?	?	?	?	
<i>Mononykus olecranus</i>	?	?	?	?	?	?	?	?	?	
<i>Shuvuuia deserti</i>	?	?	?	?	?	?	?	?	?	
<i>Patagonykus puertai</i>	?	?	?	?	?	?	?	?	?	
<i>Caenagnathus collinsi</i>	?	?	?	?	?	?	?	?	?	
<i>Chiostenotes pergracilis</i>	?	?	?	?	?	?	?	?	?	
<i>Microvenator celer</i>	?	?	?	?	?	?	?	?	?	
<i>Citipati osmolskae</i>	?	?	?	?	?	?	?	?	?	
<i>Khaan mckennai</i>	?	0	?	?	?	?	?	?	?	IGM 100/1127, IGM 100/1002; (64)
<i>Ingenia yanshini</i>	?	?	?	?	?	?	?	?	?	
<i>Conchoraptor gracilis</i>	?	?	?	?	?	?	?	?	?	
<i>Oviraptor philoceratops</i>	?	?	?	?	?	?	1	1	0	(65)
<i>Rinchenia mongoliensis</i>	?	?	?	?	?	?	?	?	?	
<i>Caudipteryx zoui</i>	?	1	1	?	?	?	?	?	1	(45)
<i>Incisivosaurus gauthieri</i>	?	?	?	?	?	?	?	?	?	
<i>Protarchaeopteryx robusta</i>	?	?	?	?	?	?	?	?	?	
<i>Avimimus portentosus</i>	?	?	?	?	?	?	?	?	?	
<i>Heyuannia huangi</i>	?	?	?	?	?	?	?	?	?	
<i>Anchiornis huxleyi</i>	?	0	?	?	?	?	?	?	?	LPM-B00169; (66)
<i>Sinovenator changii</i>	?	?	?	?	?	?	?	?	?	
<i>Mei long</i>	?	0	?	?	?	?	?	?	?	IVPP V12733; (67)
<i>Sinornithoides youngi</i>	?	0	?	?	?	?	?	?	?	IVPP V9612; (68)
<i>Byronosaurus jaffei</i>	?	?	?	?	?	?	?	?	?	
<i>IGM100/44 unnamed troodontid</i>	?	?	?	?	?	?	?	?	?	
<i>Saurornithoides mongoliensis</i>	?	?	?	?	?	?	?	?	?	
<i>Zanabazar junior</i>	?	?	?	?	?	?	?	?	?	
<i>Troodon formosus</i>	?	?	?	?	1	?	?	1	0	(69)
<i>Unenlagia comahuensis</i>	?	?	?	?	?	?	?	?	?	
<i>Buitreraptor gonzalezorum</i>	?	?	?	?	?	?	?	?	?	
<i>Rahonavis ostromi</i>	?	?	?	?	?	?	?	?	?	
<i>Sinornithosaurus millenii</i>	?	?	?	?	?	?	?	?	?	

Table S1. Cont.

Taxon	Extrinsic evidence of diet									Ref./specimen no.
	1	2	3	4	5	6	7	8	9	
<i>Microraptor zhaoianus</i>	?	0	?	?	?	?	?	?	?	CAGS 20–7-004/CAGS 20–8-001; (70)
<i>Adasaurus mongoliensis</i>	?	?	?	?	?	?	?	?	?	
<i>Velociraptor mongoliensis</i>	?	0	?	?	1	?	?	1	0	(71)
<i>Deinonychus antirrhopus</i>	?	?	?	?	1	?	?	1	0	(72)
<i>Dromaeosaurus albertensis</i>	?	?	?	?	?	?	?	?	?	
<i>Atrociraptor marshalli</i>	?	?	?	?	?	?	?	?	?	
<i>Utahraptor ostrommaysi</i>	?	?	?	?	?	?	?	?	?	
<i>Saurornitholestes langstoni</i>	?	?	?	?	1	?	?	1	0	(69, 73)
<i>Bambiraptor feinbergi</i>	?	?	?	?	?	?	?	?	?	
<i>Achillobator giganticus</i>	?	?	?	?	?	?	?	?	?	
<i>Epidexipteryx hui</i>	?	0	?	?	?	?	?	?	?	UVPPV154-71; (74)
<i>Epidendrosaurus ningchengensis</i>	?	?	?	?	?	?	?	?	?	
<i>Limusaurus inextricabilis</i>	?	1	1	?	?	?	?	?	1	(13)
<i>Archaeopteryx lithographica</i>	?	0	?	?	?	?	?	?	?	Solnhofen specimen; (75)
<i>Yanornis martini</i>	1	1	1	?	?	?	1	?	1	(22, 24)
<i>Jeholornis prima</i>	1	?	1	?	?	?	?	?	1	IVPP V13353; (76)
<i>Confuciusornis sanctus</i>	?	?	?	?	?	?	1	?	?	(25)
<i>Jinfengopteryx elegans</i>	1	?	1	?	?	?	?	?	1	(77)
<i>Sapeornis chaoyangensis</i>	?	1	1	?	?	?	?	?	1	(48)
<i>Protopteryx fengningensis</i>	?	0	?	?	?	?	?	?	?	IVPP V 11665; (78)
<i>Wellnhoferia grandis</i>	?	0	?	?	?	?	?	?	?	Solnhofen (sixth) specimen; (79)

Tabulated data on extrinsic evidence of diet in theropod taxa used to generate presence/absence states for the character “extrinsic evidence of herbivory” (EEH) in ecomorphological character correlation analyses. Extrinsic evidence of diet characters as follows: (1) herbaceous gut content: present only; (2) gastric mill: absent/present; (3) evidence of herbivory: present only; (4) evidence of predation—associated tooth marks/embedded teeth: present only; (5) evidence of predation—associated shed teeth at feeding locale or predator/prey combat: present only; (6) associated coprolite containing processed bone: present only; (7) vertebrate gut content: present only; (8) evidence of carnivory: present only; and (9) EEH: absent/present. Character 3 coded as present if characters 1 or 2 present. Character 8 coded as present if characters 4, 5, 6, or 7 present. Character 9 (EEH) coded as absent if character 8 present, and coded as present if character 3 present. Species were coded as gastroliths absent if a near-to-complete articulated skeleton with intact abdominal region lacking gastroliths is known. Please see [SI Appendix](#) for reference list.

Table S2. Chronostratigraphic age estimates for theropod species used to generate branch lengths in character correlation and rank concordance analyses

Taxon	Age estimate, Ma	Taxon	Age estimate, Ma
<i>Limusaurus inextricabilis</i>	160	<i>Conchoraptor gracilis</i>	76
<i>Allosaurus fragilis</i>	147	<i>Oviraptor philoceratops</i>	77
<i>Sinraptor dongi</i>	159	<i>Rinchenia mongoliensis</i>	69
<i>Dilong paradoxus</i>	128	<i>Caudipteryx zoui</i>	125
<i>Eotyrannus lengi</i>	128	<i>Incisivosaurus gauthieri</i>	128
<i>Tyrannosaurus rex</i>	66	<i>Protarchaeopteryx robusta</i>	125
<i>Gorgosaurus libratus</i>	75	<i>Avimimus portentosus</i>	69
<i>Tanycolagreus topwilsoni</i>	150	<i>Heyuannia huangi</i>	68
<i>Coelurus fragilis</i>	147	<i>Anchiornis huxleyi</i>	156
<i>Ornitholestes hermanni</i>	147	<i>Sinovenator changii</i>	128
<i>Compsognathus longipes</i>	150	<i>Mei long</i>	128
<i>Huaxiagnathus orientalis</i>	125	<i>Sinornithoides youngi</i>	121
<i>Sinosauropteryx prima</i>	125	<i>Byronosaurus jaffei</i>	77
<i>Anserimimus planinychus</i>	69	<i>IGM100 44 unnamed troodontid</i>	113
<i>Harpymimus okladnikovi</i>	113	<i>Saurornithoides mongoliensis</i>	77
<i>Pelecanimimus polyodon</i>	130	<i>Zanabazar junior</i>	69
<i>Archaeornithomimus asiaticus</i>	75	<i>Troodon formosus</i>	75
<i>Gallimimus bullatus</i>	69	<i>Unenlagia comahuensis</i>	92
<i>Ornithomimus edmontonicus</i>	75	<i>Buitreraptor gonzalezorum</i>	98
<i>Garudimimus brevipes</i>	95	<i>Rahonavis ostromi</i>	68
<i>Struthiomimus altus</i>	75	<i>Sinornithosaurus millenii</i>	125
<i>Shenzhousaurus orientalis</i>	128	<i>Microraptor zhaoianus</i>	120
<i>Sinornithomimus dongi</i>	96	<i>Adasaurus mongoliensis</i>	69
<i>Falcarius utahensis</i>	125	<i>Velociraptor mongoliensis</i>	77
<i>Beipiaosaurus inexpectus</i>	125	<i>Deinonychus antirrhopus</i>	108
<i>Alxasaurus elesitaiensis</i>	111	<i>Dromaeosaurus albertensis</i>	75
<i>Nothronychus mckinleyi</i>	90	<i>Atrociraptor marshalli</i>	69
<i>Erliaosaurus bellamanus</i>	75	<i>Utahraptor ostrommaysi</i>	123
<i>Nanshiungosaurus brevispinus</i>	75	<i>Saurornitholestes langstoni</i>	75
<i>Neimongosaurus yangi</i>	75	<i>Bambiraptor feinbergi</i>	75
<i>Segnosaurus galbiensis</i>	95	<i>Achillobator giganticus</i>	95
<i>Erlikosaurus andrewsi</i>	95	<i>Epidexipteryx hui</i>	160
<i>Mononykus olecranus</i>	69	<i>Epidendrosaurus ningchengensis</i>	160
<i>Shuvuuia deserti</i>	77	<i>Archaeopteryx lithographica</i>	150
<i>Patagonykus puertai</i>	92	<i>Yanornis martini</i>	120
<i>Caenagnathus collinsi</i>	75	<i>Jeholornis prima</i>	120
<i>Chirostenotes pergracilis</i>	75	<i>Confuciusornis sanctus</i>	125
<i>Microvenator celer</i>	108	<i>Jinfengopteryx elegans</i>	125
<i>Citipati osmolskae</i>	77	<i>Sapeornis chaoyangensis</i>	120
<i>Khaan mckennai</i>	77	<i>Protopteryx fengningensis</i>	130
<i>Ingenia yanshini</i>	76	<i>Wellnhoferia grandis</i>	150

Table S3. Number of confirmed and estimated CHTs per species

Taxon	No. CHTs	Taxon	No. CHTs
<i>Limusaurus inextricabilis</i>	(8)	<i>Conchoraptor gracilis</i>	9 (6)
<i>Allosaurus fragilis</i>	(0)	<i>Oviraptor philoceratops</i>	9 (8)
<i>Sinraptor dongi</i>	(0)	<i>Rinchenia mongoliensis</i>	8–9 (7)
<i>Dilong paradoxus</i>	(0)	<i>Caudipteryx zoui</i>	(16)
<i>Eotyrannus lengi</i>	(0)	<i>Incisivosaurus gauthieri</i>	(15)–16
<i>Tyrannosaurus rex</i>	(0)	<i>Protarchaeopteryx robusta</i>	14–17 (9)
<i>Gorgosaurus libratus</i>	(0)	<i>Avimimus portentosus</i>	7–8 (0)
<i>Tanycolagreus topwilsoni</i>	(0)	<i>Heyuannia huangi</i>	9 (4)
<i>Coelurus fragilis</i>	(0)	<i>Anchiornis huxleyi</i>	2–4 (1)
<i>Ornitholestes hermanni</i>	(1)–5	<i>Sinovenator changii</i>	(3)–5
<i>Compsognathus longipes</i>	(1)–2	<i>Mei long</i>	3–4 (2)
<i>Huaxiagnathus orientalis</i>	(0)–2	<i>Sinornithoides youngi</i>	(2)
<i>Sinosauropteryx prima</i>	(1)–2	<i>Byronosaurus jaffei</i>	(2)
<i>Anserimimus planinychus</i>	8 (0)	<i>IGM100 44 unnamed troodontid</i>	3–6 (0)
<i>Harpymimus okladnikov</i>	(7)–13	<i>Saurornithoides mongoliensis</i>	(2)
<i>Pelecanimimus polyodon</i>	(11)–12	<i>Zanabazar junior</i>	(2)
<i>Archaeornithomimus asiaticus</i>	7–8 (0)	<i>Troodon formosus</i>	(2)–4
<i>Gallimimus bullatus</i>	(8)	<i>Unenlagia comahuensis</i>	1–4 (0)
<i>Ornithomimus edmontonicus</i>	(8)	<i>Buitreraptor gonzalezorum</i>	1–4 (0)
<i>Garudimimus brevipes</i>	(7)	<i>Rahonavis ostromi</i>	1–4 (0)
<i>Struthiomimus altus</i>	(8)	<i>Sinornithosaurus millenii</i>	(1)
<i>Shenzhousaurus orientalis</i>	(11)	<i>Microaptor zhaoianus</i>	(2)
<i>Sinornithomimus dongi</i>	8 (7)	<i>Adasaurus mongoliensis</i>	(0)–1
<i>Falcarius utahensis</i>	(10)–12	<i>Velociraptor mongoliensis</i>	(0)
<i>Beipiaosaurus inexpectus</i>	9–17 (6)	<i>Deinonychus antirrhopus</i>	(0)
<i>Alxasaurus elesitaiensis</i>	10–17 (7)	<i>Dromaeosaurus albertensis</i>	(0)
<i>Nothronychus mckinleyi</i>	13–18 (3)	<i>Atrociraptor marshalli</i>	(0)
<i>Erliaosaurus bellamanus</i>	10–17 (0)	<i>Utahraptor ostrommaysi</i>	(0)
<i>Nanshiungosaurus brevispinus</i>	13–18 (1)	<i>Saurornitholestes langstoni</i>	(0)
<i>Neimongosaurus yangi</i>	12–16 (10)	<i>Bambiraptor feinbergi</i>	1 (0)
<i>Segnosaurus galbiensis</i>	14–17 (13)	<i>Achillobator giganticus</i>	1 (0)
<i>Erlikosaurus andrewsi</i>	16 (15)	<i>Epidexipteryx hui</i>	(16)
<i>Mononykus olecranus</i>	9–15 (3)	<i>Epidendrosaurus ningchengensis</i>	9–16 (2)
<i>Shuvuuia deserti</i>	11–14 (10)	<i>Archaeopteryx lithographica</i>	2 (1)
<i>Patagonykus puertai</i>	8–15 (0)	<i>Yanornis martini</i>	7 (6)
<i>Caenagnathus collinsi</i>	7 (5)	<i>Jeholornis prima</i>	11–12 (10)
<i>Chirostenotes pergracilis</i>	7–8 (0)	<i>Confuciusornis sanctus</i>	(7)
<i>Microvenator celer</i>	8–16 (6)	<i>Jinfengopteryx elegans</i>	9–10 (7)
<i>Citipati osmolskae</i>	8 (7)	<i>Sapeornis chaoyangensis</i>	(12)
<i>Khaan mckennai</i>	(9)	<i>Protopteryx fengningensis</i>	9–11 (8)
<i>Ingenia yanshini</i>	9 (8)	<i>Wellnhoferia grandis</i>	2–11 (0)

Estimated maximum and minimum number of ecomorphological traits exhibiting maximal congruence with EEH in theropod dinosaurs (correlated herbivorous traits—CHTs) for theropod species used in character correlation and rank concordance analyses. Numbers in parentheses indicate number of confirmed CHTs recorded for each species. Minimum estimate given as actual number of CHTs plus number of CHTs reconstructed as unequivocally state 1 using maximum parsimony ancestral state reconstructions in Mesquite v. 2.72 (80). Maximum estimate given as minimum number of CHTs plus all possible equivocal CHTs reconstructed using the same optimization technique. Data used to generate quantitative interpretations of herbivory in Fig. 2. Please see [SI Appendix](#) for reference list.

Table S4. First-order correlation results for the concentrated changes test, pairwise comparisons, and Discrete

PHT	Concentrated changes test (EEH independent) <i>P</i> value				Pairwise comparisons	Discrete	
	EEH DEL/PHT DEL	EEH DEL/PHT ACT	EEH ACT/PHT DEL	EEH ACT/PHT ACT	<i>P</i> value (no. of pairs/ correlative pairs)	LR	<i>P</i> value
(5) Dentary sym downturned, rostral gap between mandibles	0.0069**	0.008**	0.0001**	0.0032**	0.125 (3/3) N/A	11.0134**	<0.05*
(6) Cranioventral margin of dentary dorsally concave	0.0563	0.0308*	0.0021**	0.003**	0.125 (3/3) N/A	13.2153**	<0.05*
(7) Dent tooth loss	0.1698	0.1377	0.0058**	0.0035**	0.125 (3/3) N/A	11.6825**	<0.05*
(8) Rostral dentary exhibits tooth loss	0.0069**	0.009**	0.0038**	0.0072**	0.125 (3/3) N/A	6.6671**	
(9) Caudal dentary exhibits tooth loss	0.1478	0.1458	0.0128*	0.0118*	0.125 (3/3) N/A	10.1072**	<0.05*
(10) Dent sym U-shaped	0.248	0.3567	0.0937	0.1085	0.125 (3/3) N/A	9.8990**	<0.05*
(11) Dentary sym rostrally project	0.1698	0.1377	0.0058**	0.0035**	0.125 (3/3) N/A	11.1292**	<0.05*
(12) Dent teeth inset	0.8272	0.8158	0.4583	0.4495	1.0 (0/0) N/A	0.3731	
(13) Rostralmost dentary teeth conical	0.0028**	0.0896	0.0005**	0.0009**	0.125 (3/3) N/A	10.4586**	<0.05*
(14) Pmx teeth conical/incisiform	0.0028**	0.0356*	0.0005**	0.0021**	0.125 (3/3) N/A	13.4390**	<0.01**
(15) Rostral teeth conical	0.035*	0.0797	0.0412*	0.00148**	0.0625 (4/4) N/A	13.8866**	<0.01**
(16) Premaxillary teeth elongate	0.4442	0.5024	0.027*	0.0492*	0.5 (1/1) N/A	2.8115	
(17) Premaxilla edentulous	0.0528*	0.051*	0.05*	0.0477*	0.25 (2/2) N/A	8.0447**	
(18) Premaxillary teeth unserrated	0.829	0.1166	0.021*	0.0454*	0.3125 (4/3) NS	8.0137**	
(19) Replacement waves poor/absent	0.1805	0.0779	0.1291	0.1153	0.25 (2/2) N/A	8.5152**	
(20) Chk T lanceol	0.507	0.6542	0.0712	0.1247	1.0 (0/0) N/A	2.2093	
(21) Teeth symmetrical	0.0115*	0.0951	0.005**	0.00055**	0.0625 (4/4) N/A	14.3167**	<0.01**
(22) Teeth not zipho	0.00525**	0.0797	0.0116*	0.00148**	0.0625 (4/4) N/A	14.06**	<0.01**
(23) Dent hetero	0.1923	0.3567	0.0094**	0.0177*	0.5 (1/1) N/A	6.1824**	
(24) Mand sym fused	0.0885	0.0869	0.0998	0.103	0.5 (3/2) NS	5.8952**	
(25) Pmx teeth procumbent	0.3256	0.314	0.1945	0.197	0.5 (1/1) N/A	3.7097**	
(26) Dent densely packed	0.0222*	0.2307	0.0879	0.0837	0.75 (2/1) NS	10.2300**	<0.05*
(27) Mand joint vent displ	0.1923	0.3567	0.0094**	0.1085	0.125 (3/3) N/A	3.3324**	
(28) Pubic shaft concave (excl boot)	0.4991	0.5024	0.1924	0.1889	0.75 (2/1) NS	0.9594	
(29) Isch elongate	0.312	0.3137	0.0665	0.0626	0.5 (1/0) NS	6.0238**	
(30) Pub retroverted	0.1718	0.1603	0.2146	0.2099	0.25 (2/2) N/A	3.8484**	
(31) Cer verts >10	0.4064	0.6542	0.0712	0.2111	0.25 (2/2) N/A	2.7734	

First-order correlation results between PHTs and EEH (character 4) for the concentrated changes test iterations, pairwise comparisons, and Discrete. LR and *P* values reported for Discrete. Lowest *P* value reported for pairwise comparisons. LR >3 indicates positive correlation for Discrete. Values in parentheses reported for pairwise comparisons are the total number of pairs available for testing/the number of those pairs indicating a correlative relationship between EEH and listed PHT. Values <5 in which all pairs show a correlation are listed as not applicable (N/A) as the test cannot detect significance below this threshold. Values <5 in which there is contradiction among pairings listed as not significant (NS). EEH, extrinsic evidence of herbivory; PHT, putative herbivorous trait; DEL, Deltran optimization; ACT, Actran optimization; LR, likelihood ratio.

*Significant at 5%, or LR value >3.

**Significant at 1%, or LR value >5.

Table S5. First-order correlation results for concentrated changes tests with alternate topologies

PHT	Concentrated changes test (EEH independent variable) <i>P</i> value				AT1	AT2
	EEH DEL/ PHT DEL	EEH DEL/ PHT ACT	EEH ACT/ PHT DEL	EEH ACT/ PHT ACT	EEH ACT/ PHT ACT	EEH ACT/ PHT ACT
(5) Dentary sym downturned, rostral gap between mandibles	0.0069**	0.008**	0.0001**	0.0032**	0.0169	0.0183
(6) Cranioventral margin of dentary dorsally concave	0.0538*	0.0308*	0.0021**	0.003**	0.0302	0.0261
(7) Dent tooth loss	0.1698	0.1377	0.0058**	0.0035**	0.0114	0.0112
(8) Rostral dentary exhibits tooth loss	0.0069**	0.009**	0.0038**	0.0072**	0.0097	0.0272
(9) Caudal dentary exhibits tooth loss	0.1478	0.1458	0.0128*	0.0118*	0.0277	0.0272
(10) Dentary sym U-shaped	0.248	0.3567	0.0937	0.1085	0.096	0.0922
(11) Dentary sym rostrally project	0.1698	0.1377	0.0058**	0.0035**	0.0114	0.0112
(12) Dent teeth inset	0.8272	0.8158	0.4583	0.4495	0.7588	0.7529
(13) Rostralmost dentary teeth conical	0.0028**	0.0896	0.0005**	0.0009**	0.0031	0.0027
(14) Pmx teeth conical/incisiform	0.0028**	0.0356*	0.0005**	0.0021**	0.0114	0.0289
(15) Rostral teeth conical	0.035*	0.0797	0.0412*	0.00148**	0.0038	0.0077
(16) Premaxillary teeth elongate	0.4442	0.5024	0.027*	0.0492*	0.17335	0.3795
(17) Premaxilla edentulous	0.0528*	0.051*	0.05*	0.0477*	0.0277	0.0272
(18) Premaxillary teeth unserrated	0.829	0.1166	0.021*	0.0454*	0.1129	0.1166
(19) Replacement waves poor/absent	0.1805	0.0779	0.1291	0.1153	0.2032	0.2243
(20) Chk T lanceol	0.507	0.6542	0.0712	0.1247	0.5625	0.5535
(21) Teeth symmetrical	0.0115*	0.0951	0.005**	0.00055**	0.0289	0.011
(22) Teeth not zipho	0.00525**	0.0797	0.0116*	0.00148**	0.0085	0.0047
(23) Dent hetero	0.1923	0.3567	0.0094**	0.0177*	0.0764	0.0431
(24) Mand sym fused	0.0885	0.0869	0.0998	0.103	0.1433	0.1465
(25) Pmx teeth procumbent	0.3256	0.314	0.1945	0.197	0.0545	0.0547
(26) Dent densely packed	0.0222*	0.2307	0.0879	0.0837	0.1989	0.2176
(27) Mand joint vent displ	0.1923	0.3567	0.0094**	0.1085	0.0764	0.0431
(28) Pubic shaft concave (excl boot)	0.4991	0.5024	0.1924	0.1889	0.4541	0.3906
(29) Isch elongate	0.312	0.3137	0.0665	0.0626	0.1097	0.1454
(30) Pub retroverted	0.1718	0.1603	0.2146	0.2099	0.0958	0.0189
(31) Cer verts >10	0.4064	0.6542	0.0712	0.2111	0.53	0.539

First-order correlation results between PHTs and EEH (character 4) using concentrated changes tests. EEH, extrinsic evidence of herbivory; PHT, putative herbivorous trait; DEL, Deltran optimization; ACT, Actran optimization; AT1, alternate topology one; AT2, alternate topology two.

*Significant at 5%.
**Significant at 1%.

Table S6. First-order correlation results for Discrete with alternate topologies

PHT	Default topology, LR	P value	AT1, LR	P value	AT2, LR	P value
(5) Dentary sym downturned, rostral gap between mandibles	11.0134**	<0.05*	10.058058	<0.05*	10.060264	<0.05*
(6) Cranioventral margin of dentary dorsally concave	13.2153**	<0.05*	13.750532	<0.01**	13.734458	<0.01**
(7) Dent tooth loss	11.6825**	<0.05*	11.076862	<0.05*	11.076874	<0.05*
(8) Rostral dentary exhibits tooth loss	6.6671**		6.720194		6.683738	
(9) Caudal dentary exhibits tooth loss	10.1072**	<0.05*	12.700294	<0.05*	12.700606	<0.05*
(10) Dent sym U-shaped	9.8990**	<0.05*	10.5767	<0.05*	10.58216	<0.05*
(11) Dentary sym rostrally project	11.1292**	<0.05*	10.883354	<0.05*	10.8841	<0.05*
(12) Dent teeth inset	0.3731		1.020686		1.06753	
(13) Rostralmost dentary teeth conical	10.4586**	<0.05*	10.756558	<0.05*	10.740728	<0.05*
(14) Pmx teeth conical/incisiform	13.4390**	<0.01**	14.349554	<0.01**	14.347956	<0.01**
(15) Rostral teeth conical	13.8866**	<0.01**	14.407872	<0.01**	14.365836	<0.01**
(16) Premaxillary teeth elongate	2.8115		4.039794		4.043788	
(17) Premaxilla edentulous	8.0447**		7.67515		7.857398	
(18) Premaxillary teeth unserrated	8.0137**		8.143106		8.156268	
(19) Replacement waves poor/absent	8.5152**		8.143524		8.14342	
(20) Chk T lanceol	2.2093		2.832656		2.698068	
(21) Teeth symmetrical	14.3167**	<0.01**	14.06977	<0.01**	14.051374	<0.01**
(22) Teeth not zipho	14.06**	<0.01**	14.564922	<0.01**	14.520368	<0.01**
(23) Dent hetero	6.1824**		7.079108		6.986486	
(24) Mand sym fused	5.8952**		5.9655		5.719482	
(25) Pmx teeth procumbent	3.7097**		3.85532		3.810772	
(26) Dent densely packed	10.2300**	<0.05*	10.388888	<0.05*	10.38889	<0.05*
(27) Mand joint vent. displ	3.3324**		7.465268		7.46567	
(28) Pubic shaft concave (excl boot)	0.9594		0.948568		0.94857	
(29) Isch elongate	6.0238**		5.549566		6.329248	
(30) Pub retroverted	3.8484**		1.31328		1.310434	
(31) Cer verts >0	2.7734		2.764518		2.694848	

First-order correlation results between PHTs and EEH (character 4) using Discrete. LR and P values reported.

*Significant at 5%.

**Significant at 1%.

Table S7. Twenty-one PHTs correlating with extrinsic evidence of herbivory (CHTs)

First-order CHTs	Second-order CHTs
5.1 Dentary symphyseal region downturned creating rostral mandibular gap	8.1 Rostral dentary exhibits tooth loss*
6.1 Cranioventral margin of dentary ventrally concave	16.1 Premaxillary teeth elongate relative to maxillary dentition
7.1 Dentary exhibits tooth loss	17.1 Premaxilla edentulous*
9.1 Caudal dentary exhibits tooth loss	18.1 Premaxillary teeth unserrated*
11.1 Dentary symphysis rostrally projecting	19.1 Mandibles lack pronounced replacement waves between teeth*
13.1 Rostralmost dentary teeth conical	20.1 Cheek tooth shape lanceolate
14.1 Premaxillary teeth conical or subconical	23.1 Dentition heterodont*
15.1 Rostral teeth (premaxillary or dentary) conical to subconical	25.1 Premaxillary teeth procumbent
21.1 Teeth symmetrical	26.1 Dentition densely packed*
22.1 Ziphodonty lost	27.1 Mandibular joint ventrally displaced (subhorizontal with ventral margin of dentary)
	31.1 Cervical vertebrae number >10

Ecomorphological traits exhibiting maximal congruence with EEH in theropod dinosaurs (CHTs).

*Traits with enough pairs to be analyzed and detected as significant by pairwise comparisons.

Other Supporting Information Files

[SI Appendix \(DOC\)](#)