Supporting Information

For: Longrich and Currie, “A microraptorine (Dinosauria- Dromaeosauridae) from the Late Cretaceous of North America”

Supporting Information 1. Dinosaur mass data and equations

Supporting Information 2. Specimen data

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Supporting Information 1. Dinosaur mass data and equations

Table 1. Body masses and pubis lengths used for mass estimate

Taxon	Specimen	Pubis, mm	Reference	Mass, g	Reference
Archaeopteryx recurva	JM 2257	23	this study	69	(2)
Archaeopteryx lithographica	HMN 1880	41	this study	252	(3)
Microraptor gui	IVPP V13352	67.2	this study	600	GS Paul, unpublished data
Bambiraptor feinbergorum	AMNH 30556	107	this study	2100	GS Paul, unpublished data
Sinornithosaurus millennii	IVPP 12811	120	this study	3000	GS Paul, unpublished data
Velociraptor mongoliensis	IGM 100/986	213	(1)	24000	GS Paul, unpublished data
Deinonychus antirrhopus	MCZ 4371	437	This study	73000	(2)

Notes:

Institutional abbreviations—— AMNH; American Museum of Natural History, New York, New York; HMN, Humboldt Museum fur Naturkunde, Berlin, Germany; IGM, Geological Institute, Ulan Bator, Mongolia; IVPP, Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China; JM, Jura Museum, Willibaldsburg, Germany; MCZ, Harvard Museum of Comparative Zoology, Cambridge, Massachusetts ; NMC/CMN, Canadian Museum of Nature, Ottawa, Canada; TMP, Royal Tyrrell Museum of Palaeontology, Drumheller, Canada; UALVP, University of Alberta Laboratory for Vertebrate Palaeontology, Edmonton, Canada.

Methods—— Length of the pubis was measured from casts (JM 2257; HM 1880), from photographs of specimens using ImageJ image analysis software, or taken from the literature. When the data are $\log_{10}$ transformed and mass is regressed against pubis length, the resulting equation is $M = 2.4721L\text{-}1.6062$; R^2=.98674. The resulting allometric equation is:

$$M = 0.02476L^{\,2.4721}$$

Where M is mass in grams, and L is pubis length in mm. A pubis length of 95 mm therefore predicts a mass of 1918 g (4.2 lbs) for the holotype of *Hesperonychus elizabethae*.

Table 2. Body mass of predatory theropods from the Dinosaur Park Formation

Taxon	Specimen	Mass, kg	Reference
Daspletosaurus torosus	NMC/CMN 8505	3844	(4)
Gorgosaurus libratus	AMNH 5458	2795	(4)
Troodon inequalis	NMC/CMN 12340	142	(5)
Dromaeosaurus albertensis	AMNH 5356	16.29	(4)
Saurornitholestes langstoni	TMP 88.121.39	12.8	Estimated using equation 9 from reference(5) and femur circumference = 67.6mm
Ricardoestesia gilmorei	NMC/CMN 343	?	too incomplete for mass estimate
Hesperonychus elizabethae	UALVP 48778	1.9	this study

Supporting Information 2. Specimen data

Table 3: Specimens of *Hesperonychus*

Element	Specimen	Stratigraphy	Locality	Dimensions (mm)
Pelvic girdle	UALVP	Belly River Group: Dinosaur Park Fm.	E of DPP, Southern Alberta	95
Pedal phalanx II-1	TMP 1989.116.65	Belly River Group: Dinosaur Park Fm.	Cripple Creek (near Onefour) Southern Alberta	14.2
Pedal phalanx II-1	TMP 1966.19.22	Belly River Group	Manyberries, Southern Alberta	incomplete
Pedal phalanx II-1	UALVP 50049	Belly River Group: Upper Dinosaur Park Fm.	Irvine Mammal Locality, Southern Alberta	incomplete
Pedal phalanx II-2	TMP 1992.36.31	Belly River Group	DPP, Southern Alberta	11.1
Pedal phalanx II-2	TMP 1983.67.7	Belly River Group	DPP, Southern Alberta	17.1
Pedal phalanx II-2	TMP 1991.50.143	Belly River Group	DPP, Southern Alberta	4.8
Pedal phalanx II-3	TMP 1988.50.34	Belly River Group	DPP, Southern Alberta	4.8
Pedal phalanx II-3	TMP 1995.92.9	Belly River Group: Oldman Fm. (DPF equivalent)	Devil's Coulee, Southern Alberta	5.6
Pedal phalanx II-3	TMP 1991.50.105	Belly River Group: Dinosaur Park Fm.	DPP, Southern Alberta	incomplete
Pedal phalanx II-3	TMP 1988.36.68	Belly River Group: Dinosaur Park Fm.	Steveville RR Grade, NW of DPP	5.42
Pedal phalanx II-3	TMP 1980.16.1880	Belly River Group	DPP, Southern Alberta	5.6
Pedal phalanx II-3	TMP 1980.8.205	Belly River Group	DPP, Southern Alberta	6.5
Pedal phalanx II-3	TMP 1990.107.15	Belly River Group	Onefour, Southern Alberta	6.6
Pedal phalanx II-3	TMP 1979.10.6	Belly River Group	Sandy Point, Southern Alberta	incomplete
Pedal phalanx II-3	TMP 2000.12.100	Belly River Group: Dinosaur Park Fm.	DPP, Southern Alberta	6.4
Pedal phalanx II-3	UALVP 50048	Belly River Group: Upper Dinosaur Park Fm.	Irvine Mammal Locality, Southern Alberta	4.8

Notes:

Institutional abbreviations—— TMP, Royal Tyrrell Museum of Palaeontology, Drumheller, Canada; UALVP, University of Alberta Laboratory for Vertebrate Palaeontology, Edmonton, Canada.

Locality—— Most of the specimens described here (including the holotype) come from Dinosaur Provincial Park, Alberta, and nearby exposures along the Red Deer River. Seven referred specimens come from other areas of Alberta; none of these are more than 200km from Dinosaur Park (SI Figure 1).

Stratigraphy—— All specimens for which precise stratigraphic data are available come from the chronostratigraphic interval bounded by the Dinosaur Park Formation and coeval beds of the uppermost Oldman Formation. These beds encompass less than 1.7 million years of time (6). Some of the referred specimens lack precise stratigraphic data. In particular, many specimens are recorded as coming from the "Judith River Formation"; these beds are now divided into the beds of the lower Oldman Formation and the Dinosaur Park Formation, which overlies the Oldman in the Dinosaur Provincial Park area. Both formations are part of the Belly River Group (6). Most (if not all) of these Belly River Group fossils probably come from the Dinosaur Park Formation, which is more extensively exposed and more fossiliferous than the underlying Oldman.

Dimensions: dimensions measured for *Hesperonychus* are lengths of the pubis, pedal phalanx II-1, and pedal phalanx II-2, and height of the articular surface for pedal phalanx II-3. Corresponding dimensions for the holotype of *Sinornithosaurus millennii* are 120 mm, 14.9 mm, 16.8 mm, and 6.8 mm, respecticely.

SI:2 Fig. 1. Map showing localities of *Hesperonychus* holotype and referred specimens: **1**, Dinosaur Provincial Park (DPP); **2** Sandy Point; **3**, Irvine; **4**, Manyberries/Onefour, **5**, Devil's Coulee.

Appendix 3: Taxa and characters used in phylogenetic analysis

I. List of Taxa

Archaeopteryx
Sinovenator changii
Byronosaurus jaffei
Troodon
Mahakala omnogovae
Rahonavis ostromi
Unenlagia comahuensis
Unenlagia? *paynemili*
Buitreraptor gonzalezorum
Neuquenraptor argentinus
Austroraptor cabazai
Microraptor
Graciliraptor lujiatunensis
Shanag ashile
Sinornithosaurus millenii
Hesperonychus elizabethae
Saurornitholestes langstoni
Atrociraptor marshalli
Bambiraptor feinbergi
Velociraptor mongoliensis
Itemirus medullaris
Tsaagan mangas
Adasaurus mongoliensis
Deinonychus antirrhopus
Dromaeosaurus albertensis
Utahraptor ostrommaysi
Achillobator giganticus

II. List of characters

Skull

1. Premaxilla, maxilla, and dentary bearing distinct interdental plates [0] or interdental plates absent [1] (7)
2. Premaxilla elongate [0], or body of premaxilla short, no more than 15% length of maxilla [1]
3. Premaxilla with short maxillary process [0] or elongate maxillary process separating nasal and maxilla [1] (8)
4. Premaxilla: body of premaxilla longer than tall [0] or at least as tall as long [1]
5. Nasal process of premaxilla projecting posterodorsally [0] or posteriorly [1]
6. Premaxilla with limited exposure of narial fossa on lateral surface [0] or with prominent anteroventral extension of narial fossa onto lateral surface of premaxilla [1]

7. Maxilla does not contribute to narial fossa [0] or narial fossa expanded onto anterior ramus of maxilla [1]
8. Maxilla, postantral wall concealed in lateral view [0] or caudally projecting into antorbital fenestra and exposed in lateral view [1] (9)
9. Maxilla, palatal shelf concealed in lateral view [0], or palatal shelf projecting dorsally into the antorbital fenestra and visible in lateral view [1]
10. Maxilla, promaxillary fenestra subcircular and broadly exposed in lateral view [0] or slitlike, largely concealed in the anteroventral margin of antorbital fossa [1] (10)
11. Maxilla, anterior ramus elongate, 25% or more of the length of maxilla [0] or short, less than 25% length of maxilla [1]
12. Maxilla, accessory antorbital fenestra large and subcircular [0] or small and subcircular [1] or anteroposteriorly elongate [2] UNORDERED
13. Maxilla, accessory antorbital fenestra positioned low in antorbital fossa [0] or placed dorsally in antorbital fossa [1] (12)
14. Maxilla, accessory antorbital fenestra developed as a simple perforation [0] or located in distinct fossa [1] or located in a fossa containing a deep and pitlike excavation posterodorsal to the accessory antorbital fenestra [2] UNORDERED [Modified from (12)]
15. Maxilla, labial margin smooth [0] or maxilla with a distinct lip bounding the ventral margin of the antorbital fossa [1]
16. Maxilla, anterior ramus longer than tall [0] or short, at least as tall as long [1]
17. Maxilla, interfenestral bar separating maxillary fenestra and antorbital fenestra: narrow [0] or broad [1]
18. Nasals concave in lateral view [0] or straight to convex in lateral view [1] [2]
19. Frontal, orbital margin straight or smoothly concave in dorsal view [0] or postorbital process sharply offset, and orbital margin L-shaped in dorsal view [0] (13)
20. Frontal notched to recieve lacrimal: absent [0] or present [1] (13)
21. Frontal, supratemporal fossa smooth [0] or supratemporal fossa with a distinct pit [1] (13)
22. Frontal, supratemporal fossa restricted to the lateral half of the frontal [0] or supratemporal fossa extends medially [1]
23. Jugal, suborbital ramus slender [0] or dorsoventrally deep and robust [1]
24. Jugal, postorbital process slender; jugal triradiate [0] or postorbital process broad, and jugal triangular [1]
25. Quadratojugal with straight ascending ramus [0] or ascending ramus bowed anteriorly [1]
26. Quadrate shaft pierced by large foramen: present [0] or absent [1]
27. Quadrate shaft straight or weakly curved in lateral view [0] or strongly bowed anteriorly in lateral view [1]
28. Exoccipital, caudal surface with a bowl-like depression containing the exits of cranial nerves X and XII: absent [0], or present [1] (8)
29. Exoccipital, paroccipital processes of exoccipital project ventrolaterally [0] or laterally [1] [(8), polarity reversed]
30. Basioccipital tubera, caudal surfaces flat or smoothly concave [0] or basioccipital tubera with distinct, ovoid depressions on the caudal surface [1]
31. Basioccipital tubera separated by weak notch [0] or separated by a deep, broad, U-shaped ventral notch [1]
32. Basisphenoid recess with paired openings: absent [0] or present [1]
33. Prominent lateral depression of braincase bounded by otosphenoidal crest: absent [0] or present
34. Foramen magnum subcircular [0] or distinctly taller than wide [1]
35. Dentary subtriangular, with dorsal and ventral margins diverging posteriorly [0] or dentary dorsal and ventral margins subparallel [1] (13)
36. Dentary with prominent groove along the length of the lateral surface [0] or lateral groove reduced anteriorly or absent [1] (8)
37. Dentary straight or weakly curved in lateral view [0] or strongly bowed, with curved dorsal and ventral margins [1]

38. Dentary with distinct midlength constriction and terminal expansion: absent [0] or present [1]
39. Articular with tall, columnar process on retroarticular process: absent [0] or present [1]
40. Skull short [0] or elongate, at least 125% length of femur [1] (14)

Dentition

41. Teeth constricted between crown and root [0] or constriction absent [1] (15)
42. Premaxillary and anterior dentary teeth unserrated [0] or bearing denticles on posterior carina [1] (8)
43. Premaxillary teeth 2-4 subequal in size [0] or second premaxillary tooth larger than third and fourth [1] (13)
44. Maxillary teeth number fewer than 20 [0] or numbering at least 20 [1] [modified from (8)]
45. Maxillary teeth strongly raked posteriorly: absent [0] or present [1] (16)
46. Maxillary teeth subequal in length along the jaw [0] or posterior maxillary teeth elongate and fanglike, approximately 200% the length of anteriormost maxillary teeth [1]
47. Maxillary and posterior dentary teeth unserrated [0] or bearing denticles on posterior carina only [1] or bearing denticles on anterior and posterior carina [2] UNORDERED [modified from (17)]
48. Maxillary and posterior dentary teeth, denticles: anterior denticles smaller than posterior denticles [0] or anterior and posterior denticles subequal in size [1] (7)
49. Anterior dentary teeth closely packed: absent [0] or present [1]

Axial skeleton

50. Axis vertebra bearing short epipophyses [0] or elongate axial epipophyses that project laterally beyond postzygapophyses [1] (18)
51. Cervical vertebrae, carotid processes present [0] or carotid processes absent [1] (17)
52. Cervical vertebrae with low neural spines [0] or cervical neural spines at least as tall as long anteroposteriorly [1]
53. Dorsal vertebrae, parapophyses short [0] or borne on elongate pedicels [1] [1]
54. Dorsal vertebrae, pneumatopores absent [0] or present on dorsal centra [1] (19)
55. Dorsal vertebrae, neural spines low, height does not exceed anteroposterior length [0] or taller than long anteroposteriorly [1]
56. Dorsal vertebrae, neural arch bearing prominent anterior fossae on either side of neural canal: absent [0] or present [1]
57. Dorsal vertebrae, centra of posterior dorsals elongate [0] or short and massive, length of centrum less than diameter [1]
58. Dorsal vertebrae, distal end of neural spines transversely expanded by at least 200% to form a distinct spine table: absent [0] or present [1]
59. Sacral vertebrae, 5 vertebrae incorporated into sacrum [0] or sacrum incorporating at least 6 vertebrae [1] (10)
60. Sacral vertebrae lack pneumatopores [0] or pneumatopores present in one or more sacral vertebrae [1] (19)
61. Caudal vertebrae, distal caudal centra bearing prominent lateral depressions [0] or lateral surfaces of centra flat or convex [1]
62. Caudal vertebrae, distal caudals greatly elongated, up to 200% the length of proximal caudals [0] or moderately elongate, no more than 200% the length of the proximal caudals [1]
63. Caudal vertebrae, distal caudal vertebrae with a convex or flat dorsal surface [0] or bearing a prominent dorsal groove [1] (20)
64. Caudal vertebrae, prezygapophyses short [0] or elongate [1] or extended by ossified tendons of caudal epaxial muscles [2] (7)

Pectoral Girdle

65. Sternal plates unossified [0] or ossified [1] [Modified from (17)]
66. Furcula, interclavicular angle less than 90º [0] or at least 90º [1]
67. Coracoid highly flexed in lateral view, with dorsal and ventral rami of coracoid forming an angle of 90º-100º [0] or coracoids weakly flexed, forming an angle larger than 100º
68. Coracoid elongate, taller than wide [0] or short, at least as wide as tall [1]

Forelimb

69. Humerus elongate, at least 75% length of femur [0] or shortened, humerus less than 75% length of the femur [1]
70. Humerus, internal tuberosity proximodistally short [0] or proximodistally elongate, about 50% the length of deltopectoral crest [1]
71. Humerus, proximal shaft with prominent longitudinal ridge on posterior surface: absent [0] or present [1]
72. Manual phalanx I-1 strongly bowed in medial view [0], weakly curved or straight [1]
73. Manual phalanx III-1 elongate, at least 75% length of III-3: absent [0] or present [1] [modified from (21)]
74. Metacarpal I no more than 33% length of mtc II [0] or metacarpal I more than 33% length of MC II [1]
75. Manual phalanx I-1 elongate [0] or short, combined length of metacarpal I and manual phalanx I-1 < MC II [1] (21)

Pelvic Girdle

76. Ilium, anterior wing 200% length of posterior wing [0] or short, less than twice length of posterior blade [1]
77. Ilium, end of anterior wing rounded or straight [0], or with notched cranial margin [1]
78. Ilium, cuppedicus ridge ends on pubic peduncle [0] or extends posteriorly to acetabulum [1] (22)
79. Ilium, medial antiliac shelf (22) short [0] or elongate, approaching length of posterior wing [1]
80. Ilium, posterior wing of ilium slender, shallower than anterior wing [0] or posterior wing as deep or deeper than anterior wing [1]
81. Ilium, posterior wing longer than tall [0] or posterior wing at least as tall as long [1]
82. Ilium with acuminate caudal margin [0] or brevis shelf lobate and projecting posteriorly beyond postacetabular lamina [1] or brevis shelf notched in lateral view [2] [modified from (14)]
83. Ilium, posterior wing with straight or convex dorsal margin [0] or concave dorsal margin [1] (22)
84. Ilium, pubic peduncle narrow in lateral view [0] or broad, anteroposterior width approximately 200% of height [1]
85. Pubis, distal end with prominent posterior expansion [0] distal end spatulate, both anterior and posterior expansions absent [1] or with prominent anterior and posterior expansions [2] [UNORDERED] [modified from(8)]
86. Pubis, shaft straight or gently curved [0] or distal end of shaft strongly bent posteriorly [1] (11)
87. Pubis, lateral surface of shaft smooth or bearing a ridge [0] or with enlarged tubercles or processes [1] (11)
88. Pubis, Pubic apron extends less than 50% length of pubis [0] or pubic apron elongate, at least 50% length of pubis [1] (23)
89. Ischium short, no more than 50% length of pubis [0] or elongate, more than 50% length of pubis [1]
90. Ischium, obturator process located at distal end of shaft [0] or located at midshaft [1] or proximally located [2] [ORDERED] [(8), polarity reversed]
91. Ischium, proximodorsal process present [0] or absent [1] or hypertrophied [2] UNORDERED (24)

92. Ischium with distal dorsal process prominent [0] or highly reduced or absent [1] (25)
93. Ischium, lateral ridge on shaft absent [0] or present [1] (14)
94. Ischium, obturator process elongate and spur-like [0] or broad and flange-like [1]
95. Ischium with obturator process separated from ischial shaft by caudal notch [0] or confluent [1] (10)
96. Ischium, distal end tapers to a narrow point [0] or broadly expanded, blunt or spatulate end [1]
97. Ischium, shaft mediolaterally compressed [0] or subcircular in section [1] (14)
98. Ischium, ridge on medial surface connecting proximodorsal process and iliac peduncle: absent [0], or present [1]

Hindlimb

99. Femur with femoral head projecting dorsomedially or medially relative to shaft [0] or femoral head projects ventromedially [1]
100. Metatarsal II and phalanx II-1 articulate via ginglymoid articulation: absent [0] or present [1] (8)
101. Metatarsal II, subequal to IV in length [0] or markedly shorter than IV [1] (10)
102. Metatarsal II, distal condyles broad, subequal to III in width: absent [0] or present [1]
103. Metatarsal III, plantar surface broadly exposed [0] or metatarsal III largely covered by metatarsal III and IV in ventral view [1]
104. Metatarsal III, dorsal surface of shaft flat or rounded [0] or with prominent longitudinal sulcus [1]
105. Metatarsal IV, distal surface trochlear to planar [0] or condyle strongly ball-shaped [1]
106. Metatarsal IV, prominent flange on caudolateral surface of shaft: present [0] or highly reduced or absent [1] (26)
107. Metatarsal IV, lateral flange on proximal end of shaft: absent [0] or present [1]
108. Metatarsal IV, ventral surface with a prominent tuber proximal to distal articular surface: absent [0] or present [1]
109. Pedal phalanx II-1 elongate [0] or short and robust, shaft length does not exceed 200% the diameter of the distal condyle [1]
110. Pedal phalanx II-2 proximoventral heel: short [0] or with elongate caudal projection [1]
111. Pedal phalanx II-2 slender to moderately robust [0] or Iextremely massive, shaft diameter at least 50% of shaft length [1]
112. Pedal phalanx II-2 subequal to or longer than, II-1 [0] or significantly shorter than II-1 [1]
113. Pedal phalanx II-2 with deep collateral ligament pits [0] or ligament pits reduced [1]
114. Pedal phalanx II-3; lateral and medial vascular grooves at same level [0] or lateral groove dorsally displaced and medial groove ventrally displaced [1]

Notes:

The analysis was conducted at the generic level, and so several taxa are coded from more than one species. The taxon *Archaeopteryx* includes *Archaeopteryx lithographica*, and smaller specimens that likely represent a second, small-bodied species, *Archaeopteryx recurva* (27). *Microraptor* includes the type species *Microraptor zhaoianus* as well as *Microraptor gui*. *Troodon* is coded from *Troodon* sp. from the Two Medicine Formation of Montana, *Troodon inequalis* from the Belly River Group of Alberta, and *Troodon* sp. from the Horseshoe Canyon Formation of Alberta. However, *Unenlagia comahuensis* and *Unenlagia*? *paynemili* differ markedly in the morphology of the humerus and ilium, raising questions about whether the two are congeneric. Therefore, these species were coded separately. *Neuquenraptor argentinus* may be synonymous with either *Unenlagia comahuensis* or *Unenlagia*? *paynemili*, but at present there is too little information to resolve this issue.

The taxonomy employed for this study follows previous studies (28, 29, 14) with the following amendments:

Eudromaeosauria is defined as the least inclusive clade containing *Saurornitholestes langstoni*, *Deinonychus antirrhopus*, *Dromaeosaurus albertensis*, and *Velociraptor mongoliensis*. The clade has been found to be monophyletic by a number of recent analyses (14, 26, 29,30).

Saurornitholestinae is defined as the most inclusive clade containing *Saurornitholestes langstoni* but not *Dromaeosaurus albertensis*, *Velociraptor mongoliensis*, or *Microraptor zhaoianus*. This clade is supported by the following derived characters: deep pit caudodorsal to accessory antorbital fenestra (14:2), sacral vertebrae pneumatized (60:1), ridge on medial surface of ischium ventral to proximodorsal process (98:1). Within Dromaeosauridae, characters 14 and 98 appear to be unique to this clade.

Appendix 4: Data matrix

Archaeopteryx
000000000000000000000000??000???0?1000000000000!00?0000?0000000000000000000000
?000000000000000000?001100??0?000000

Sinovenator changii
01000010000200000?0?0000?100000?010010??0001001!1???000?0000??????11??????????
0??0?0?001000001??000010100010?00?00

Byronosaurus jaffei
0100111????2000010???????????00?110010??00?1010!1??000??????0?1???????????????
????????????????????????????????????

Troodon
1?0???10010210001?(01)000???0100000110000??01?100211?000010?1?01?11????00?????
????????2000?1110110000010100000011100

Mahakala omnogovae
??????????????????0000????0?0??00????????????????0????????10?100????????????0?
?0000???????????????01?001????00?01

Rahonavis ostromi
??110000110001????0??????0011
000110000002?00??000111011000000101

Unenlagia comahuensis
??111101?????????111????0011
011110101012?01??001???????????????

Unenlagia? paynemili
??0????????????11????????
?111?2101????????????????????0?????

Buitreraptor gonzalezorum
1??????10??20?0?001?0?00?00???????0001?110??0?0!0?0?100?00??0?01?00?011???????
??011??1???10110000?11011??00???????

Neuquenraptor argentinus
??
????????????????????10?11?00000010?

Austroraptor cabazai
0?0???010002000010110100??????????0011?110?1000!0?0?11??01??????????11????????
???????????????????????????????01?0?

Microraptor
101100????1???1???????????????????1110?01010011!0?00100?000?00?21(01)??0000101
1?0?000?01110000000000?01111?100?00000?

Graciliraptor lujiatensis
???0????20????????0???0?02????????101????
????????????????????1111?????00000?

Shanag ashile
1?1???000?111100??????????????????0010??10??011!0?????????????????????????????
????????????????????????????????????

Sinornithosaurus millennii
1011??0???11111??00111??0?????????101010101001200????0??000????21?0001?010111?0
??0??1110000000000??1??1?100??0000?

Hesperonychus elizabethae
???0?
??0001110??????????????????????????

Saurornitholestes langstoni
1?11?000110112010?1111??110???????1110101?1000200???11111?(01)11?021?11010?????
????????????00111100101?0001000110?01

Atrociraptor marshalli
10110000110112010?????????????????1100??111010200??????????????????????????????
???????????????????????????????????

Bambiraptor feinbergi
101100000011120101?0?1001110?010??1110?01??0101!0?1111111001100211110101100100
000000000100011110010110001000110001

Velociraptor mongoliensis
10101101010100000011111010011111001110?01110002001111(01)1?11101102111111010101
10010000200111111111000110001111110001

Itemirus medullaris
???????????????????????????1?11?00???
???????????????????????????????????

Tsaagan mangas
?0?01101010?0000001?0111001100110101101?1110001!01?1??????????????????????????
????????????????????????????????????

Adasaurus mongoliensis
1010?10?0?0???01??????11??1??????1110??1?1000?10?????1?1???????????????????1100
10?00200?1111?110????????????11?1??

Deinonychus antirrhopus
1011000001011101011?11100??1??????11101?11?01020011111011??1102??1111010101100
00000200101111111000110001100110101

Dromaeosaurus albertensis
1?1???0?001???01??11011001001000001100 1?11?000210??????????????????????????????
????????????????????1?0??1?1111111?

Utahraptor ostrommaysi
???100??????????????????????????????????111????1????11101???1?02??11?????????00
?0200?????201011?1001?000?1111????1

Achillobator giganticus
1?1???0?0?0???01????????????????????????1??00021??11111?1???1?01???????????1100
1120020011201011110 01?0?0?????11?1?

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