第52卷 第3期
2014年7月

古 脊 椎 动 物 学 报
VERTEBRATA PALASIATICA

pp. 316–327
figs. 1–5

New materials of the Late Miocene *Muntiacus* from Zhaotong hominoid site in southern China

DONG Wei[1] JI Xue-Ping[2] Nina G. JABLONSKI[3] Denise F. SU[4] LI Wen-Qi[5]

(1 *Key Laboratory of Vertebrate Evolution and Human Origins of Chinese Academy of Sciences, Institute of Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences* Beijing 100044, China dongwei@ivpp.ac.cn)
(2 *Research Center for Southeast Asian Archeology & Yunnan Institute of Cultural Relics and Archaeology* Kunming 650118, China)
(3 *Department of Anthropology*, *the Pennsylvania State University* University Park, PA 16802, USA)
(4 *Department of Paleobotany and Paleoecology*, *Cleveland Museum of Natural History* Cleveland, OH 44106, USA)
(5 *Zhaoyang Museum* Zhaotong, Yunnan 657000, China)

Abstract Rescue excavations carried out from 2007 to 2010 at the Shuitangba lignite field in Zhaotong, Yunnan Province, not only resulted in the discovery of a new hominoid cranium and the addition of a new hominoid site in Yunnan, but the finding of a new muntjak with following characters: the brow tine is very close to the burr, which is moderately developed; the main beam extends backward and somewhat laterally, and then turns somewhat medially; and the neocrista and entocingulum are developed on the upper molars. The four limbs are relatively short. A cladistic analysis shows that the new materials represent a muntjak that is not in a sister-group relationship with *Muntiacus leilaoensis* from Yuanmou Late Miocene hominoid site, but rather represents an independent branch. *Muntiacus zhaotongensis* sp. nov. is proposed for the new muntjak materials. "*Metacervulus* sp." from the "Yongle lignite field" recovered in 1978 is a synonym of the new species. The so-called "Yongle lignite field" is actually the Shuitangba lignite field. The layers yielding the materials of *M. zhaotongensis* sp. nov. are all within C3An.1n based on paleomagnetic correlation, with an estimated age between 6.1 to 5.9 Ma (terminal Miocene).

Key words Zhaotong, Yunnan; Late Miocene; hominoid; *Muntiacus*, Artiodactyla

1 Introduction

Mammalian fossils from the Zhaotong (formally spelled as "Chaotung") lignite beds collected by a researcher from the Yunnan Provincial Museum were first noted by Prof. Zhou Mingzhen (Minchen Chow) in 1960; the fossil sites were investigated by Qiu Zhanxiang and Wang Banyue in 1960 (Chow, 1961; Chow and Zhai, 1962). Shi Mozhuang and colleagues from the Beijing Natural History Museum investigated a lignite mine called the "Yongle lignite field" of Yongle Village in 1978 in collaboration with 143 Coal Geology Exploration Team of Yunnan and collected some mammalian fossils, including a muntjak antler of "*Metacervulus* sp." (Shi et al., 1981). The mine was originally named Shuitangba and was renamed Yongle

云南省科技厅基础研究重点项目(编号：2010CC010)、国家自然科学基金(批准号：41372027, 40925012)、昭通市人民政府和美国国家科学基金(编号：BCS 1035897, BCS 1227838)资助。
收稿日期：2013−12−09

during the period from 1966-1979. Some lignite fields were surveyed again during the implementation of State Key Project of the 9th Five-Year Plan—Origin of Early Humans and Environmental Background from 1998 to 2000. Since 2007, Ji Xueping and his team have carried out a series of rescue excavations at the Shuitangba lignite mine, the same mine as the one investigated by Shi and his team in 1978. A juvenile hominoid face tentatively assigned to *Lufengpithecus* cf. *lufengensis* was uncovered in 2009 (Ji et al., 2013). The mammalian fossils associated with the hominoid materials include *Sinocastor*, *Kowalskia*, *Pliopetaurista*, *Alilepus*, *Miorhizomys*, cf. *Stegodon zhaotongensis*, cf. *Sinomastodon* sp., they indicate an age no older than the latest Miocene and no younger than Pliocene. And the hominoid layer was paleomagnetically correlated within C3An.1n with an absolute age from 6.1 to 5.9 Ma (Ji et al., 2013). Other mammalian materials include some antlers, teeth, and limb bones of some cervids. Here we report on some of the muntjak materials uncovered in 2007, 2009, and 2010, and describe a new muntjak species. The terminology for cervid anatomy follows Dong (2004, 2008).

2 Systematic description

Mammalia Linnaeus, 1758

Artiodactyla Owen, 1848

Cervoidea Gray, 1821

Cervidae Gray, 1821

Muntiacinae Pocock, 1923

***Muntiacus* Rafinesque, 1815**

***Muntiacus zhaotongensis* sp. nov.**

1981 *Metacervulus* sp., Shi et al., p.9-10

Holotype A nearly complete right antler with pedicle (ZT-07-01-245), housed in the Yunnan Institute of Cultural Relics and Archaeology, Kunming.

Included materials A left antler with pedicle and associated portion of the frontal (ZT-10-0391) from Layer 11; a left maxillary fragment with DP3-M3 (ZT-07-01-266); 3 isolated left molars (ZT-09-03-297) from Layer 9; a right metacarpus (ZT-10-0199) from Layer 10; a broken left metatarsus (ZT-09-03-577) from Layer 10.

Type locality Shuitangba lignite mine, Zhaotong Municipality, Yunnan Province, China.

Type stratum Lignite bed with mollusks, sand and gravels, the terminal Miocene.

Etymology The species is named after the name of the municipality where the type is found.

Diagnosis A medium-sized muntjak. The brow tine is very close to the burr, which is moderately developed. The main beam extends backward and slightly laterally, and then turns slightly medially. The neocrista and entocingulum are developed on upper molars. The limbs

are relatively short.

Description The type specimen ZT-07-01-245 (Fig. 1A) is a right mature but unshed antler (see Table 1 for measurements) from an adult individual. Its pedicle is nearly complete but is fractured on the medial side. The pedicle is broken off the frontal. The pedicle is nearly straight and its cross section is somewhat triangular. Its surface is smooth. Although the burr is broken on the posterior side, it is moderately developed and composed of series of bony nodes. The brow tine is very small and very close to the burr. The main beam is thick, developed backward and slightly laterally at first and then curved medially for two thirds of its length. It is flattened near the base. The ornamentation of the antler is formed by well-developed longitudinal grooves and crests on the surface of the antler crown.

The left antler (ZT-10-0391) is a mature, unshed antler from a sub-adult individual (Fig. 1B). Its pedicle is complete, thin, and attached to a portion of the frontal. The pedicle is thin and long and arises from the frontal postero-dorsally. Its proximal end extends onto the frontal to form a developed ridge. Its surface is smooth and its cross section in the proximal part is somewhat semicircular, and that in the distal part is nearly oval. The burr is well preserved and moderately developed, formed by a series of bony tubercles and appears as an oval rosary. The brow tine is tiny and developed very close to the burr. The main beam is moderate, developed

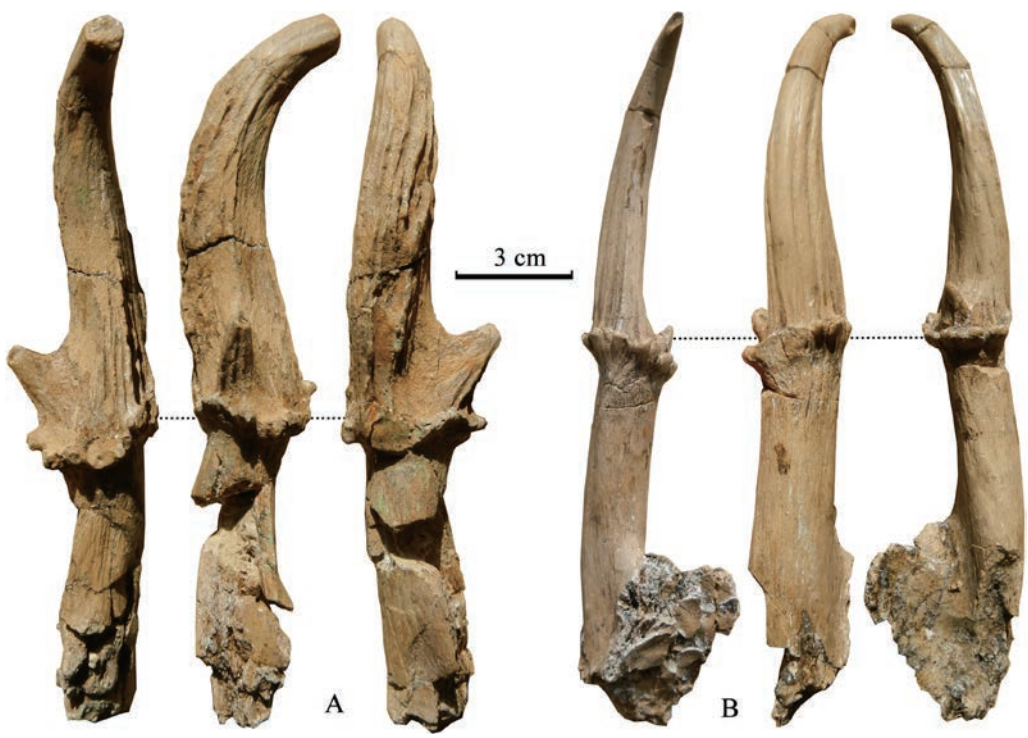

Fig. 1 Antlers of *Muntiacus zhaotongensis* sp. nov.
A. frontal, lateral and occipital views (from left to right) of holotype (ZT-07-01-245);
B. occipital, lateral and frontal views (from left to right) of left antler (ZT-10-0391)

backward and laterally at first and then curved medially for two thirds of its length. The ornamentation of the antler is formed by moderately developed longitudinal grooves and crests on the surface of the antler crown (see Table 1 for measurements).

The preserved left upper maxillary fragment (ZT-07-01-266) is composed of two deciduous premolars and three molars (Fig. 2). The DP3 is formed by three main cusps, the protocone on lingual side, and the paracone and metacone on the buccal side. Its length is much longer than its width. The DP4 is composed of four main cusps and molarized. Its length and width are nearly the same. Its morphology is quite simple, e.g. the accessory elements such as cingula, neocrista, entostyle, etc. are absent. The M1, M2 and M3 are all composed of four main cusps; their length and width are close to each other. Accessory elements such as neocrista, entocingulum, entostyle, etc. are developed (Fig. 3). Measurements of the cheek teeth are listed in Table 2.

A right metacarpus (ZT-10-0199) was identified (Fig. 4A). Its proximal articular

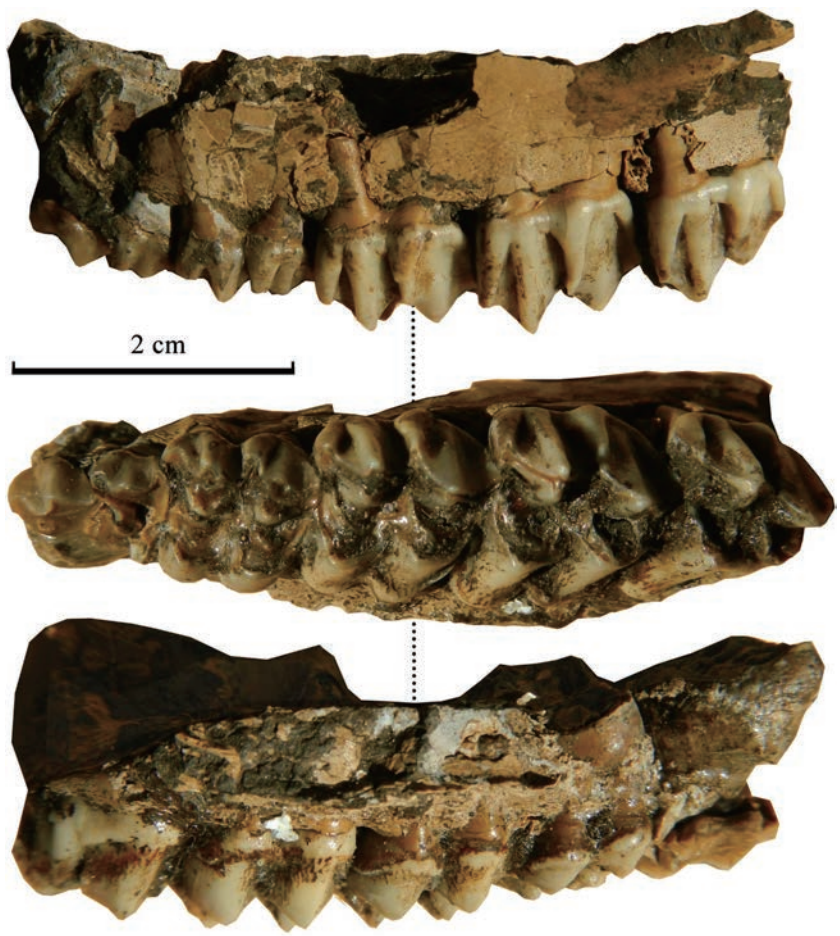

Fig. 2 Buccal, occlusal and lingual (from upper to lower) views of the left maxillary fragment with DP2-M3 (ZT-07-01-266) of *Muntiacus zhaotongensis* sp. nov.

Table 1 Measurements of antlers of *Muntiacus zhaotongensis* sp. nov. from Shuitangba and comparison with those of related muntjaks (mm)

	M. zhaotongensis		*M. leilaoensis*		*M. bohlini*
	ZT-07-01-245	ZT-10-0391	PDYV 1762	PDYV 1833	RV 40002
Medial length of pedicle	>35	40.45	>58.00	86.48	28
Lateral length of pedicle	>67	74.02	>86.70	124.60	43
Max diameter of proximal pedicle	20.13	18.04	18.04	18.14	17.7
Min diameter of proximal pedicle	20.32	14.69	15.76	14.46	13.6
Max diameter of distal pedicle	20.10	16.44	18.82	18.56	17.1
Min diameter of distal pedicle	16.94	14.02	16.40	15.68	14.5
Thickness of burr	6.32	4.56	7.22	5.96	4.3
Max diameter of burr	33.03	25.52	39.46	38.78	21.4
Min diameter of burr	29.62	23.23	37.24	33.12	18.7
Length of antler base	18.48	7.38	22.32	12.24	16
Angle of bifurcation	40°	35°	40°		40°
Max diameter of proximal antler base	24.36	16.54	23.38	30.12	28.5
Min diameter of proximal antler base	16.53	11.79	21.22	22.16	16.9
Length of the main beam	90.05	73.23	>95.10	125.10	58
Max diameter of proximal main beam	24.42	16.04	21.86	23.82	17.3
Min diameter of proximal main beam	16.72	11.68	14.58	14.92	11.8
Length of the brow tine	9.82	6.31	8.02		8.6
Max diameter of proximal brow tine	9.47	7.26	9.74		9.6
Min diameter of proximal brow tine	5.89	4.59	8.68		8.4

surface is composed of a lateral facet for articulation with the unciform and a medial facet for articulation with the capitato-trapezoid. The lateral facet is smaller and close to a triangle and the medial one is larger and somewhat rectangular. In dorsal (anterior) view, a shallow metacarpal gully is present on dorsal (anterior) surface of the diaphysis. The gully sets about at the proximal part of the diaphysis as a small foramen. In palmar (posterior) view, a long depression lies along palmar surface of the diaphysis. The depression starts up from the proximal part of the diaphysis as a large nutritional foramen. The medial pulley is evidently longer than the lateral one. But on the distal view, two pulleys appear nearly symmetric.

A left metatarsus (ZT-09-03-577) was identified (Fig. 4B). Its proximal articular surface is composed of four facets; the two anterior ones are much larger than the posterior ones; both anterior and posterior lateral facets articulating with the cubonavicular; and the anterio-medial one articulating with the grand cuneiform, the posterio-medial facet articulating with the small cuneiform. A small ridge separates the lateral and medial facets. A moderate gully is present along the dorsal (anterior) surface of the diaphysis and a developed depression lies along the palmar (posterior) surface of the diaphysis. The medial pulley is a little longer than the lateral one. And on the distal view, two pulleys look nearly symmetric.

The measurements of the limb bones are listed in Table 3.

Comparison The Zhaotong materials are similar to those of *M. leilaoensis* from Yuanmou (Dong et al., 2004). The length of the main beams are nearly the same, the growth direction of the main beam is also the same. The burr of the Yuanmou specimens is more developed, however, and the brow tine is set higher in the adult specimens. Compared with

Table 2 Measurements of the cheek teeth of *Muntiacus zhaotongensis* sp. nov. from Shuitangba compared with those of *M. bohlini* (RV40002) and extant *Muntiacus* sp. (OV 949) (mm)

	ZT-07-01-266	ZT-09-03-297	RV 40002	RV 40002	OV 949	OV 949
			L	R	L	R
P2 L			8.92	9	9.62	9.62
P2 W			9.48	8.7	9.96	10.1
P2 H			9.42		6.38	6.42
P3 L	10.31*		8.52	8.76	9.62	9.66
P3 W	6.23*		10.18	9.84	11.56	11.72
P3 H	4.77*		8.98	8.08	5.92	6.72
P4 L	9.72*		9.02	10.02	8.24	8.54
P4 W	10.72*		9.28	10.58	11.88	11.48
P4 H	5.56*			9.66	5.38	6.3
P2-4 L			28.24	26	28.1	28.04
M1 L	10.61	9.88	11.22	12.16	10.86	10.26
M1 W	12.19	11.35	11.02	11.28	11.96	11.94
M1 H	8.22	7.81	8	5.96	3.58	3.68
M2 L	11.13	10.33	11.98	12.44	12.02	11.96
M2 W	13.62	12.19	13.18	12.38	13.18	13.08
M2 H	9.91	8.75	10.36	10.42	3.72	4.84
M3 L	10.51	9.9	12.64	12.76	12.54	12.64
M3 W	12.88	11.67	12	11.82	13.5	13.06
M3 H	8.99	8.6	11.64	9.32	4.34	4.88
M1-3 L	29.88		36.2	36.18	33.82	34.28
P2-M3 L			64.64	64.34	60.24	60.28

* deciduous teeth.

Table 3 Measurements of the limb bones of *Muntiacus zhaotongensis* sp. nov. from Shuitangba (mm)

	PAPD	PTD	DAPD	DTD	L
ZT-10-0199 metacarpus	9.38	12.87	7.53	13.66	80.15
ZT-09-03-577 metatarsus	18.34	17.16	21.33	12.78	144.16

Abbreviations: PAPD. proximal anterior-posterior diameter; PTD. proximal transversal diameter; DAPD. distal anterior-posterior diameter; DTD. distal transversal diameter; L. length.

M. bohlini (Teilhard de Chardin, 1940), the pedicle of the Zhaotong specimens is longer; the burr is moderately developed in both the Zhaotong specimens and *M. bohlini*; the brow tine is similar in both the Zhaotong specimens and *M. bohlini*, but the main beam of the Zhaotong specimens appears longer; the upper molar dentition is larger in *M. bohlini*; the neocrista is developed in the Zhaotong specimens and absent in *M. bohlini*; the entocingulum is developed in the Zhaotong specimens but only moderately developed in *M. bohlini*. Compared with an extant muntjak (IVPP OV 949), the Zhaotong dentitions are a little smaller (Table 2); the neocrista is developed in the Zhaotong specimens but absent in OV 949.

Discussion Zhaotong is the fifth hominoid site in Yunnan Province. Three of the five sites have yielded muntiacine materials, i.e. Xiaolongtan, Yuanmou and Zhaotong. The materials from Yuanmou are limited to relatively well preserved antlers; they are from sandy clay or clayey sand dated 7–8 Ma (Yue et al., 2004). Those from Xiaolongtan are fragmentary and can only be identified at the subfamily level; they are from lignite beds dated as the early stage of the Late Miocene (Dong, 1987; 2001). The muntjak specimens from Zhaotong are

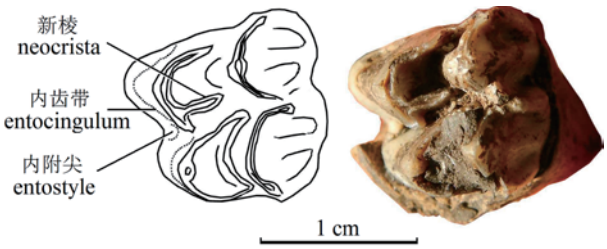

Fig. 3 Occlusal view of an isolated left M3 (ZT-09-03-297) of *Muntiacus zhaotongensis* sp. nov.

bifurcation, the main beam is short, and the brow tine is tiny. The antler is not similar to that of *Metacervulus* established by Teilhard de Chardin and Trassaert (1937), nor to that described by Hu (1962) and Dong and Hu (1994). It is actually an antler from a *Muntiacus* that is nearly the same as the antlers described in the present paper. The main differences between *Muntiacus* and *Metacervulus* are that the antler of the latter has a second bifurcation on the main beam and the main beam is much longer than that of the former (Teilhard de Chardin and Trassaert, 1937). According to the local collaborator who participated in the excavation in 1978, the Yongle lignite field was renamed from Shuitangba during the period from 1966-1979, but the mine regained its original name during the 1990s. The locality that Shi and colleagues investigated in 1978 is no longer there due to mining activities. But based on the description by Shi et al. (1981), the layer yielding "*Metacervulus* sp." and other "Late Pliocene" mammals is evidently higher in the stratigraphic sequence than those yielding the also from lignite beds, but the materials are relatively plentiful and diverse and include antlers, dentitions, and limb bones. The first muntjak material from the Yongle lignite field in Zhaotong, a mature antler, was identified as *Metacervulus* sp. and dated to the Late Pliocene (Shi et al., 1981). Study of the antler indicates that it has only one

Fig. 4 Metacarpus (A) and metatarsus (B) of *Muntiacus zhaotongensis* sp. nov.
A. proximal, dorsal (anterior), palmar (posterior) and distal views of right metacarpus (ZT-10-0199); B. proximal, palmar (posterior), dorsal (anterior) and distal views of left metatarsus (ZT-09-03-577)

hominoid materials and muntjak materials described in the present paper. But the layer is also within C3An.1n based on the stratigraphic and paleomagnetic correlations of Ji et al. (2013). The Zhaotong muntjak existed around 6 Ma, with a range from 6.1 to 5.9 Ma. Lignite is usually formed from rich plant deposits and indicates a forested environment. The wooded paleoenvironment represented by the Shuitangba lignite layers (Ji et al., 2013; Jablonski et al., in press) conforms to the habitat preferences of modern muntjaks (Nowak and Paradiso, 1983; Sheng, 1992; Wang, 2003) and suggests that the Zhaotong muntjak had similar habitat preferences as their extant relatives.

3 Phylogenetic status

The Zhaotong cervid materials described here can be assigned unequivocally to *Muntiacus*. They are morphologically similar to those of *M. leilaoensis* (Dong et al., 2004) from Yuanmou that are associated with *Lufengpithecus hudienensis*. The Zhaotong materials are from a horizon dated about 6 Ma (Ji et al., 2013), at least 1 Ma younger than Yuanmou materials from the horizon dated 7–8 Ma (Yue et al., 2004; Qi et al., 2006). In order to test if the new materials represent an independent species or a taxon (i.e. subspecies) within *Muntiacus leilaoensis* and to determine the phylogenetic position of the Zhaotong muntjak, a cladistic analysis was carried out with following characters (modified from Dong, 2007):

1. Parallel pedicles: (0) no; (1) yes;
2. Position of pedicle: (0) above orbit; (1) behind orbit;
3. Pedicle crest on frontal: (0) weak; (1) medium; (2) developed;
4. Backward pedicle inclination: (0) weak; (1) medium; (2) strong;
5. Compressed pedicle: (0) no; (1) yes;
6. Burr development: (0) weak; (1) medium; (2) strong; ordered;
7. Antler basal segment: (0) absent; (1) present; (2) developed;
8. Centripetal mineralization of antler: (0) absent; (1) present;
9. Cross section of main beam base: (0) nearly round; (1) oval; (2) elongated;
10. The growth style of the main beam: (0) nearly straight; (1) simply curved; (2) multi-curved; ordered;
11. Main beam size: (0) small; (1) medium; (2) large;
12. Brow tine size: (0) small; (1) medium; (2) large;
13. Angle between main beam and brow tine: (0) small; (1) large;
14. Antler shedding: (0) uncertain; (1) irregular; (2) regular;
15. Antler ornamentation: (0) absent; (1) present; (2) developed;
16. Antler size: (0) small; (1) medium; (2) large;
17. *Palaeomeryx* fold on lower molars: (0) present; (1) absent; ordered;
18. Relation between nasal and maxilla: (0) separate; (1) connected;
19. Anterior margin of lacrimal: (0) with projection; (1) without projection;
20. Lacrimal pit: (0) small; (1) medium; (2) large;

21. Metatarsal length: (0) short; (1) medium; (2) long;

22. Frontal gland: (0) absent; (1) present;

23. Body size: (0) small; (1) medium; (2) large; ordered;

24. Neocrista on upper molar: (0) absent; (1) present; (2) developed;

25. Entocingulum on upper molar: (0) developed; (1) present; (2) disappeared; ordered;

26. Postmetaconule crista: (0) absent; (1) present; (2) developed.

Some muntjak taxa along with more primitive and more derived cervid taxa were selected for inclusion in the data matrix (Table 4, modified from Dong, 2007).

The data matrix was edited with NEXUS Data Editor (Version 0.4.8 by Roderic D. M. Page) and the matrix was then processed with PAUP* (Version 4.0b10 for 32-bit Microsoft Windows by David L. Swofford). The best trees and a strict consensus tree were saved and then organized with TreeViewX (Version 0.5.0 by Roderic D. M. Page).

The heuristic tree search tried 119076 rearrangements and found 57 most parsimonious trees. The strict consensus tree (Fig. 5) rooted using the default outgroup shows that the tree length = 60, consistency index (CI) = 0.6833, homoplasy index (HI) = 0.3167, retention index (RI) = 0.7654, and a rescaled consistency index (RC) = 0.5230. The character-status summary for the consensus tree shows that of 26 total characters, 5 characters were of the "ordered" type (Wagner), and 21 characters were of the "unordered" type. All characters had equal weight; 4 characters were parsimony-uninformative, and 22 characters were parsimony-informative. Characters 1−5, 7−8, 14, 17, 22 and 24−26 were not homoplastic (CI = 1), and the rest of the characters were more or less homoplastic, with CI ranging from 0.333 to 0.667. The strict consensus tree (Fig. 5) has 10 nodes for 18 taxa (outgroup included), 7 nodes with dichotomous branching and the other with multiple branching (node 25 has a maximum of 6 branches). Node 25 was supported by characters 6 and 10, node 20 by characters 10, 20 and 21, and node 24 by characters 10, 15 and 24. That *M. zhaotongensis* sp. nov. probably derives from node 24 is supported by characters 6 and 25; that *M. leilaoensis* derives from node 20 is supported by character 13. The phylogenetic position of *M. zhaotongensis* sp. nov. is between the common muntjaks (composed of *M. bohlini*, *M. feae*, *M. reevesi*, *M. lacustris*, *M. leilaoensis* and *M. muntjak*) and advanced muntjaks (composed of large-sized muntjaks such as *M. noringenensis*, *M. vuquangensis*

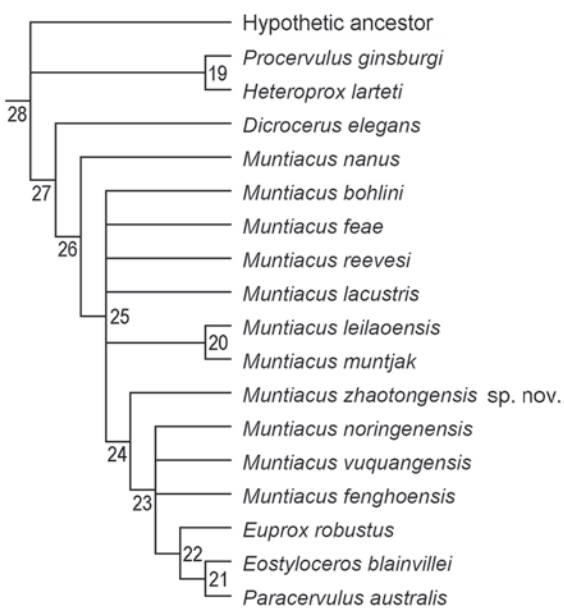

Fig. 5 The strict consensus tree based on 57 best trees

and *M. fenghoensis*, and large muntiacines such as *Euprox robustus*, *Eostyloceros blainvillei* and *Paracervulus australis*).

Table 4 Data matrix of the characters

Taxa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Hypothetic ancestor	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Procervulus ginsburgi [1]	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	?	?	?	?	?	0	?	?	?
Heteroprox larteti [2]	1	0	?	0	0	0	1	0	0	0	0	1	0	0	0	0	?	?	?	?	?	?	0	?	?	?
Dicrocerus elegans [3]	0	1	0	0	1	1	0	0	1	0	1	2	0	1	1	1	0	?	?	?	?	?	1	?	?	?
Muntiacus nanus [4]	?	?	?	?	?	1	1	1	1	0	0	0	0	2	1	0	?	?	?	?	?	?	0	?	?	?
Muntiacus bohlini [5]	0	1	2	2	0	1	1	1	1	1	0	0	0	2	1	0	1	?	?	1	?	?	0	0	1	0
Muntiacus lacustris [4]	?	?	?	?	?	2	1	1	2	1	0	0	0	2	1	0	?	?	?	?	?	?	0	?	?	?
Muntiacus leilaoensis [6]	0	1	2	2	0	2	1	1	1	2	0	0	1	2	1	0	?	?	?	?	?	?	0	?	?	?
Muntiacus zhaotongensis sp. nov.	0	1	2	2	0	1	1	1	1	2	0	0	0	2	2	0	?	?	?	?	0	?	0	2	0	0
Muntiacus reevesi [7]	0	1	2	2	0	2	1	1	1	1	0	0	0	2	1	0	1	0	1	2	0	1	0	?	?	?
Muntiacus muntjak [7]	0	1	2	2	0	2	1	1	1	2	0	0	0	2	1	0	1	1	1	0	1	1	0	0	1	0
Muntiacus feae [7]	0	1	2	2	0	2	1	1	1	1	0	0	0	2	1	0	1	1	0	2	1	1	0	?	?	?
Muntiacus noringenensis [8]	?	?	?	?	?	2	1	1	2	1	1	1	1	2	1	1	?	?	?	?	?	?	1	?	?	?
Muntiacus fenghoensis [9]	?	?	?	?	?	2	1	1	1	2	1	1	0	2	2	1	?	?	?	?	?	?	1	?	?	?
Muntiacus vuquangensis [10]	0	1	2	2	0	2	1	1	1	2	1	1	0	2	2	1	?	1	?	2	2	1	1	?	?	?
Eostyloceros blainvillei [4]	0	1	1	1	0	2	1	1	0	1	2	2	0	2	1	2	?	?	?	?	2	?	2	?	?	?
Euprox robustus [11]	0	1	1	1	0	2	1	1	0	1	1	1	0	2	2	2	1	?	?	?	2	?	2	2	1	2
Paracervulus australis [3]	0	1	1	1	0	2	2	1	0	0	2	1	0	2	2	2	1	?	?	?	2	?	2	1	1	2

Characters sources: 1) Azanza, 1993; 2) Thenius, 1948; 3) Viret, 1961; 4) Teilhard de Chardin and Trassaert, 1937; 5) Teilhard de Chardin, 1940; 6) Dong et al., 2004; 7) Ma et al., 1986; 8) Dong, 2007; 9) Chow, 1956; 10) Schaller and Vrba, 1996; 11) Dong et al., 2003. "?" in the matrix means missing character due to incomplete material.

4 Conclusion

The new muntjak materials associated with the Zhaotong hominoid from the Shuitangba lignite field unearthed between 2007 and 2010 and the "*Metacervulus* sp." unearthed from the same lignite field but slightly higher in the sequence (Shi et al., 1981) are morphologically the same and represent a new muntjak species. They are from layers that can be correlated to C3An.1n (6.1–5.9 Ma). Cladistic analysis based on the available data shows that Zhaotong muntjak associated with *Lufengpithecus* cf. *L. lufengensis* is not a sister group of *M. leilaoensis* associated with *Lufengpithecus hudienensis*, but is the sister group of a clade composed of large-sized muntjaks (*M. noringenensis*, *M. vuquangensis*, and *M. fenghoensis*)and large muntiacines (*Euprox robustus*, *Eostyloceros blainvillei* and *Paracervulus australis*). *Muntiacus leilaoensis* is a sister species of extant *M. muntjak* and forms a monophyletic group; this implies the latter can be considered as a chronospecies of the former. It is clear that Zhaotong taxon is phylogenetically independent from both *M. leilaoensis* and *M. muntjak* and can be established as a new species. The wooded paleoenvironment of Shuitangba (Ji et al., 2013; Jablonski et al., in press) indicates that the new muntjak species had similar habitat preferences and occupied a similar ecological niche during the terminal Miocene as their modern relatives.

华南昭通古猿产地的晚中新世麂属新材料

董 为[1] 吉学平[2] Nina G. JABLONSKI[3] Denise F. SU[4] 李文奇[5]

(1 中国科学院古脊椎动物与古人类研究所，中国科学院脊椎动物演化与人类起源重点实验室 北京 100044)

(2 云南省文物考古研究所，东南亚考古研究中心 昆明 650118)

(3 美国宾夕法尼亚州立大学人类学系 University Park, PA 16802)

(4 美国克利夫兰自然历史博物馆古植物与古生态部 Cleveland, OH 44106)

(5 昭阳区博物馆 云南昭通 657000)

摘要：2007~2010年在云南昭通水塘坝砖厂采煤场进行的抢救性采掘中不仅出土了禄丰古猿新材料，使得云南的禄丰古猿产地新增了一处，而且还出土了一种麂的新材料。这种麂具有鹿角眉枝较低、主枝先向外侧偏上方向生长然后再向内侧弯曲，上臼齿具有发育的新棱和内齿带，四肢较短等特征。根据支序分析这种麂与元谋晚中新世雷老麂不是姐妹群关系，而是一个独立的支序，因此将新材料订立为一个新种：昭通麂(*Muntiacus zhaotongensis* sp. nov.)。1978年在昭通“永乐煤场”出土的“后麂(*Metacervulus* sp.)”也当归为昭通麂，而“永乐煤场”即为水塘坝煤场。根据古地磁地层对比的结果，昭通麂的出土层位均相当于C3An.1n, 绝对年龄在6.1~5.9 Ma, 为最晚中新世。

关键词：云南昭通，晚中新世，古猿，偶蹄目，麂属

中图法分类号：Q915.876 **文献标识码**：A **文章编号**：1000-3118(2014)03-0316-12

References

Azanza B, 1993. Systématique et évolution du genre *Procervulus*, cervidé (Artiodactyla, Mammalia) du Miocène inférieur d'Europe. C R Acad Sci Paris, Ser II, 316: 713−723

Chow M C, 1956. A new fossil muntjac from central Shansi. Acta Palaeont Sin, 4(2): 229−232

Chow M C, 1961. Occurrence of *Enhydriodon* at Yuanmou, Yunnan. Vert PalAsiat, 6(2): 164−167

Chow M C, Zhai R J, 1962. Early Pleistocene mammals of Chaotung, Yunnan, with notes on some Chinese stegodonts. Vert PalAsiat, 6(2): 138−147

Dong W, 1987. Miocene mammalian fauna of Xiaolongtan, Kaiyuan, Yunnan Province. Vert PalAsiat, 25(2): 116−123

Dong W, 2001. Upper Cenozoic stratigraphy and paleoenvironment of Xiaolongtan Basin, Kaiyuan, Yunnan Province. In: Deng T, Wang Y eds. Proceedings of the Eighth Annual Meeting of the Chinese Society of Vertebrate Paleontology. Beijing: China Ocean Press. 91−100

Dong W, 2004. The dental morphological characters and evolution of Cervidae. Acta Anthrop Sin, 23(suppl): 286−295

Dong W, 2007. New Material of Muntiacinae (Artiodactyla, Mammalia) from the Late Miocene of northeastern Qinghai-Tibetan Plateau, China. C R Palevol, 6(5): 335−343

Dong W, 2008. A review on morphology and evolution of antlers. In: Dong W ed. Proceedings of the Eleventh Annual

Meeting of the Chinese Society of Vertebrate Paleontology. Beijing: China Ocean Press. 127−144

Dong W, Hu C K, 1994. The Late Miocene Cervidae from Hounao, Yushe Basin, Shanxi. Vert PalAsiat, 32(3): 209−227

Dong W, Liu J H, Pan Y R, 2003. A new *Euprox* from the Late Miocene of Yuanmou, Yunnan Province, China, with interpretation of its paleoenvironment. Chinese Sci Bull, 48: 485−491

Dong W, Pan Y R, Liu J H, 2004. The earliest *Muntiacus* (Artiodactyla, Mammalia) from the Late Miocene of Yuanmou, southwestern China. C R Palevol, 3: 379−386

Hu C K, 1962. A new species of *Metacervulus* of Yushe, Shansi, with notes on Pliocene munjaks of China. Vert PalAsiat, 6(3): 251−261

Jablonski N G, Su D F, Flynn L et al. (in press). The site of Shuitangba (Yunnan, China) preserves a unique, terminal Miocene fauna. J Vert Paleont

Ji X P, Jablonski N G, Su D F et al., 2013. Juvenile hominoid cranium from the terminal Miocene of Yunnan, China. Chinese Sci Bull, 58: 3771−3779

Ma S L, Wang Y X, Xu L, 1986. Taxonomic and phylogenetic studies on the genus *Muntiacus*. Acta Theriol Sin, 6(2): 190−209

Nowak R M, Paradiso J L, 1983. Walker's Mammals of the World. Baltimore & London: The Johns Hopkins University Press. 1−1362

Qi G Q, Dong W, Zheng L et al., 2006. Taxonomy, age and environment status of the Yuanmou hominoids. Chinese Sci Bull, 51: 704−712

Schaller G B, Vrba E S, 1996. Description of the giant muntjac (*Megamuntiacus vuquangensis*) in Laos. J Mammal, 77: 675−683

Sheng H L, 1992. Deer of China. Shanghai: Press of Normal University of Eastern China. 1−305

Shi M Z, Guan J, Pan R Q et al., 1981. Pliocene mammals collected from lignite in Zhaotung, Yunnan. Mem Beijing Nat Hist Mus, 11: 1−15

Teilhard de Chardin P, 1940. The fossils from locality 18, near Peking. Palaeont Sin, 124: 1−100

Teilhard de Chardin P, Trassaert M, 1937. Pliocene Camelidae, Giraffidae and Cervidae of S.E. Shansi. Palaeont Sin, New Ser C, 102: 1−56

Thenius E, 1948. Zur Kenntnis der fossilen Hirsche des Wiener Beckens, unter besonderer Berücksichtigung ihrer stratigraphischen Bedeutung. Ann Naturhist Mus Wein, 56: 262−307

Viret J, 1961. Artiodactyla. In: Piveteau J ed. Traité de Paléontologie. VI, 1. Paris: Masson et Cie Edit. 1038−1084

Wang Y X, 2003. A Complete Checklist of Mammal Species in China—A Taxonomic and Geographic Reference. Beijing: China Forestry Publishing House. 1−394

Yue L P, Zhang Y X, Qi G Q et al., 2004. Paleomagnetic age and palaeobiological significance of hominoid fossil strata of Yuanmou Basin in Yunnan. Sci China, Ser D, 47: 405−411