KATALOG
CATALOGUE

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Revised catalogue of ceratomorph ungulates in the collection of the National Museum Prague and several other collections in the Czech Republic (Perissodactyla: Rhinocerotidae, Tapiridae)

Revidovaný katalog ceratomorfních kopytníků sbírky Národního musea v Praze a několika dalších sbírek v České republice (Perissodactyla: Rhinocerotidae, Tapiridae)

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Abstract. A commented list of tapir and rhinoceros specimens deposited in the collection of the National Museum in Prague and several other Czech collections is presented. The list contains 186 specimens and 190 collection items of ceramorphs, belonging to two species of tapirs (*Tapirus indicus*, *T. terrestris*) and five species of rhinoceroses (*Ceratotherium simum*, *C. cottoni*, *Diceros bicornis*, cf. *Dicerorhinus sumatrensis*, *Rhinoceros unicornis*). Although the majority of specimens are represented by wild born animals, their scientific value is limited due to the absence of geographical origin (mainly in tapirs) and/or morphological characters evidencing their geographical pecularities (e.g. only horns preserved from rhinoceroses). The collections of the National Museum in Prague and Zoological Museum in Protivín contain several captive born individuals of tapirs and numerous specimens of captive rhinoceroses. These specimens of known age are well available for the calibration of age determination based on teeth eruption and wear, and for detecting of some captivity-induced changes in their somatic parameters. The most unique specimens include four captive northern white rhinoceroses (*Ceratotherium cottoni*) and a hybrid female between southern and northern white rhinoceroses.

Key words. Ceratomorpha, Rhinocerotidae, Tapiridae, *Ceratotherium cottoni*, museum collections, catalogue.

This paper is dedicated to all former or present zoo curators and keepers in the Dvůr Králové Zoo who have sincerely attempted to save the northern white rhinoceros from extinction and L. C. (Kees) Rookmaaker for his enthusiastic activity connected with the Rhino Resource Center.

INTRODUCTION

The group of ceratomorph ungulates (Ceratomorpha), tapirs and rhinoceroses, represents a sister lineage to horses and their relatives (Hippomorpha) (Willoughby 1974, Price & Bininda-Emonds 2009). They have produced a variety of more or less peculiar forms since the Eocene and even the largest terrestrial mammal that ever existed, *Indricotherium* (e.g. Granger & Gregory 1936, Groves 1997). The extant four tapir and six rhinoceros species (Grubb 2005, Groves et al. 2010) seem to be only a small remain of former extensive diversity of the group. On the other hand, they are no less charismatic, attractive and informative (cf. Rhino Resource Center). For instance, extant tapirs and rhinoceroses calibrate all reconstructions of life and morphology in extinct species of Ceratomorpha (see e.g. Hagge 2010); the recent occurrence of tapirs is an excellent example of the vicariant distribution; the contrasting black-white skin colouration in the Malay tapir has the analogy in a very limited number of mammalian species (Guthrie 2005); and they also belong to the charismatic and important flagship species of nature conservation and protection initiatives (IUCN, Rhino Resource Center, WWF, IRF, etc.).

Tapirs and particularly rhinoceroses initially suffered from hunting by travellers and farmers (Rookmaaker 2007) or trophy hunting as one of the favorite activities of noblemen, mainly of the first third of the 20th century (e.g., Němec 1930, Machulka 1958, Herne 2001, Slabová & Slaba 2010, etc.). At present, they suffer especially from habitat destruction (e.g. Brooks et al. 1997, Amin et al. 2006) and poaching for supposed medicinal or even aphrodisiac properties (Groves 1993a) – no wonder that ceratomorphs belong among the most threatened animal groups from the global perspective (e.g. Brooks et al. 1997, Foose & van Strien 1997, Emslie & Brooks 1999). This situation is even more critical, if the present geographical fragmentation and evolutionary isolation are considered (Amin et al. 2006, Fernando et al. 2006). Considering the evolutionary isolation, it should be remembered that some of the now accepted subspecies have been probably isolated for a very long time, deserving separate conservation and management actions, e.g. two surviving subspecies of *Rhinoceros sondaicus* in Vietnam and Java (Fernando et al. 2006) or both subspecies of *Ceratotherium simum*, recently elevated at the species level (Groves et al. 2010). Reviewing extinct ceratomorphs collected in the last century (Harper 1945, Grubb 2005, Haas 2010, IRF) and using modern revisions (Groves 1967a, b, 1993b, 1997, Rookmaaker & Groves 1978, 1997, Groves et al. 2010 for rhinos), we did not identify any extinct form of tapir, but several extinct taxa of extant rhinoceros species: *Diceros bicornis bicornis*, *D. b. brucii*, *D. b. longipes*, *Dicerorhinus sumatrensis lasiotis*, and *Rhinoceros sondaicus inermis*. Moreover, *Rhinoceros sondaicus annamiticus*, *Ceratotherium cottoni* and *Dicerorhinus sumatrensis harrisoni* are critically endangered, balancing on a brink of extinction (e.g. Fernando et al. 2006, Hillman-Smith 2006, van Strien et al. 2008).

Considering relative rarity of ceratomorph ungulates and history of the former Austria-Hungary and Czechoslovakia, i.e. countries territorially preceding the present Czech Republic, which did not rule any colonial realm, one could rather expect a poor presence of tapirs and rhinoceroses in Czech museums. Here we present evidence of ceratomorph specimens kept in museum institutions of the Czech Republic. Most of the specimens were collected from trophy assemblages and from captive animals. The largest collection is housed in the National Museum (Natural History), Prague, but a number of specimens is kept in other collections in the Czech Republic (see below). Museums in Úsov, in Protivín and in Holice posses small numbers of ceratomorph specimens, other collections consist of isolated specimens only. The material of ceratomorphs in Czech collection has not yet been published; some rhinoceros photographs were presented by Štepánek (1975), albeit as an illustration accompaniment only. Most of the

specimens are represented as osteological preparations (including horns), the limited exceptions are particularly described.

MATERIAL AND METHODS

We attempt to identify, verify or comment collection specimens primarily deposited in the National Museum (Národní muzeum), Prague, and all additional specimens deposited in several other collections (see Abbreviations). The first author (JR) addressed Czech institutions (all museums, castles etc.) which could potentionally store material of ceratomorphs and surveyed all available collection catalogues/reports (Varga 1973, Hůrka 1981, Řepa 1986, Heráň et al. 1998, Hanák et al. 1999, 2001, 2003, Hanák & Hudeček 2000, 2002, 2003, Anděra 2001, Hudeček et al. 2002a, b, 2003, Hudeček & Hanák 2003, Hanák 2005). The first author attempted to visit all collections as much as possible, but some isolated specimens across various institutions remained unrevised by the authors or were even found inaccessible in some rare cases.

Species identity was (re-)determined by the first author (JR), using the following literature: tapirs: Hatcher (1896), Ameghino (1909), Simpson (1945), Hershkovitz (1954), and Holbrook (2002); rhinoceroses: Carter & Hill (1942), Colbert (1942), Pocock (1945a), Schaurte (1966), Groves (1967a, b, 1971, 1972, 1975), Groves & Kurt (1972), Laurie et al. (1983), Hillman-Smith & Groves (1994), and Groves et al. (2010). Some zoologists are of the (premature) opinion that horn morphology is not diagnostic for species or genus determination in rhinoceroses, but Groves (1971) showed the contrary evidence based on grooved or frayed horn base and several indexes. These criteria were used for species/genus determination of horns of the unknown or somewhat uncertain place of origin.

We operationally define "normal condition" for skulls/horns based on these conditions: the skull is undamaged, with no clearly detectable traction epiphyses of the lachrymal tubercle (Cave 1965); normal dental formula is present and teeth are undamaged or of the normal shape (for the opposite condition see e.g. Hooijer 1961); the first horn is longer and slender in contrast to the shorter and wider second horn; border between the horn base and stem is relatively well distinguishable; colour on the stem is darker than on the base. We therefore note only exceptions from these states and other unusual conditions in our basic descriptions of the specimens.

We attempt to specify the age of all specimens based on the suture condition (open or closed) and standard stages of dental eruption or wear. Dental criteria proposed by Maffei (2003) for *Tapirus terrestris* were operationally used for all tapir species, although the age determination/estimation in tapirs is certainly much complicated and not yet resolved (Salas 2003, M. Colbert, pers. comm.). Criteria for the relative age determination proposed by Groves (1967b) were used for all rhinos; white rhinoceroses were also specified based on the criteria proposed by Hillman-Smith et al. (1986b), and black rhinoceroses based on the criteria proposed by du Toit (1987a). We attempt to specify the age of dermoplastic specimens of tapirs based on general body coloration according to Adachi (2004), although this was designed based on one captive Malay tapir only. We originally tried to specify the age based on shape and size of horns according to Adcock & Emslie (2007), but we abandoned this survey for several reasons (e.g. limited original diagnoses, presence of many isolated horns, a portion of subjectivity etc.).

In the catalogue, basic description of specimens is provided, as well as the available information on the geographical origin of the respective specimen, original description and notes translated to English under origin (**O**) and different specific notes (species/subspecies and age determination, some additional observations and notes) under notes (**N**). Where the identification is only approximate, the uncertainty is designated (cf.).

We measured skulls, mandibles and horns only, not postcranial skeletons. We originally tended to measure canine length and diameter for tapirs, but we do not mention these measurements here, because canines were often abraded or otherwise damaged, and a border between tooth neck and crown was often poorly definable. Measurements of tapirs were generally taken according to Simpson (1945) and Padilla & Dowler (1994), but some additional measurements were also taken according to du Toit 1987a (originally applied for the black rhinoceros); skull and mandible measurements of rhinoceroses were inspired

by Groves (1967a, b, 1993b), von Driesch (1976), Guérin (1980), but generally taken according to du Toit 1987a; measurements of horns were predominantly taken according to Groves (1971), but the following additional measurements were also taken: straight lengths, conture length of the posterior edge and heights of the basal region from all sides. Standard skull, mandible and horn measurements for all (juvenile-adult) specimens are mentioned in Tables 1–3. The dimension values are given in millimetres (if not shown elsewhere). In some cases, the standard measurements could not be obtained exactly due to their preservation (e.g. damages, mobility of some region) and/or inaccessibility (e.g. solid montage of skull with mandible or logistic inaccessibility). The first author personally visited all below mentioned collections and attempted to document, measure and revise all specimens.

The taxonomic arrangement follows Grubb (2005) and Groves et al. (2010). Taxonomic identification of horns is sometimes associated with rhinoceros subfamilies only (cf. Groves 1971); viz. subfamily Rhinocerotinae consisting of the genera *Dicerorhinus* and *Rhinoceros*, and Dicerotinae of *Ceratotherium* and *Diceros*.

ABBREVIATIONS

Collections. HFM – Museum of Hunting and Forestry, Úsov (for details see Hanák et al. 2003); IAMF – Institute of Anatomy, First Faculty of Medicine, Charles University, Prague (for details concerning the collection see Seichert et al. 2006); ISZ – Department of Zoology, Charles University, Prague (for some details see Robovský & Benda 2006); NMP – National Museum (Natural History), Prague (collection numbers with prefices 'P6V'; for details see e.g. Štěpánek 1975, Robovský & Benda 2006); ZMP – Zoological Museum, Protivín (for some details see Robovský et al. 2009); Zoo-Dvur – collection of the East Bohemian Zoological Garden in Dvůr Králové nad Labem (Dvůr Králové Zoo); Zoo-Ostrava – collection of the Zoological Garden in Ostrava (Ostrava Zoo).
Cranial Dimensions. ACn – mandible height (condylar process); ACr – mandible height (coronoid process); AF – facial height; AO – occipital height; BO – occipital depth; CV – dorsal concavity (in midline); LB – basal length; LCb – condylobasal length; LD – dorsal length; LDm – dorsal length (in midline); LF – short lateral facial length; LN – greatest length of the nasals; LMd – length of the mandible (infradentale-gonion caudale); LPN – length between prosthion and most aboral tip of nasals; LSM – mandible symphysis length (inner view); LaAO – ante-orbital breadth; LaCO – greatest breadth of the occipital condyls; LaI – least breadth between orbits (LaI+ – between fronto-parietales crests in rhinos); LaM – greatest mastoid breadth; LaN – greatest breadth of the nasals; LaNc – greatest neurocranium breadth; LaO – occipital breadth; LaPO – post-orbital breadth; LaSO – sub-orbital breadth; LaZ – zygomatic breadth; M^2 – M^2 height; PC – condyle depth; PO – occipital depth; PMi – length of the lower cheektooth row (measured according to du Toit 1987a); PMs – length of the upper cheektooth row (measured according to du Toit 1987a).
Horn Dimensions. ABA – height of the basal portion, anterior side; ABS – height of the basal portion, left side; ABP – height of the basal portion, posterior side; ABD – height of the basal portion, right side; DBA – anteroposterior diameter of the base; DBT – transversal diameter of the base; DCA – anteroposterior diameter of the stem; DCT – transverse diameter of the stem; LCA – contour length of the horn taken on the anterior side; LCP – contour length of the horn taken on the posterior side; LC – straigth length of the horn taken from apex to base; LCD – straight length of the horn taken from apex to the foot in the right angle.
Others. a.n. – accession number; (D) – right side; N: – notes; O: – origin; (S) – left side.

CATALOGUE

Tapiridae

Tapirus indicus Desmarest, 1819

NMP 9896; well preserved mounted specimen with black-white contrast coloration (currently placed in the permanent NMP exhibition). **O**: *Tapirus indicus*, adult coloration; pregnant ♀, purchased from Hagenbeck or Umlauff in 1894 for 50 marks, prepared by Štrof, unknown geographical origin; a.n.

206/1895. **N**: age estimation: adult of the age of 105 days or more according to Adachi (2004). One relatively well developed and striped calf foetus was removed during preparation (Štěpánek 1975), see NMP 9898 below.

NMP 9898; well preserved dermoplastic specimen with striped coloration (Fig. 1; currently placed in the permanent NMP exhibition). **O**: *Tapirus indicus*, juvenile; a.n. 207/1895. **N**: age estimation: juvenile of the age of less than 51 days according to Adachi (2004). This calf was removed as a foetus from the pregnant ♀ NMP 9896 during the preparation (Štěpánek 1975).

NMP 25961; disarticulated skeleton with skull, hyoid bones, scapulae and limb bones without phalangi, pelvis and sacrum; skull and mandible well preserved. Upper dentition: in perfect condition; all incisors and canines erupted, six molariforms fully erupted; both M^3 in evidence, but not fully erupting from the maxilla. Lower dentition: all incisors and canines erupted, I_3 (D) absent; only five molariforms fully erupted; both M_3 in evidence, but not fully erupting from the mandible. **O**: *Tapirus indicus*, ♀, Dvůr Králové Zoo, 23 February 1977; a.n. 44/77. **N**: *Tapirus indicus*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. The actual age of this captive female is unknown (I. Máslová, pers. comm., Dvůr Králové Zoo).

NMP 46459 (skeleton), **NMP 51176** (skin); complete disarticulated skeleton with corneous hooves and associated preserved skin; skull and mandible well preserved, with isolated incisors, canines and molariforms (probably due to the age of this individual and not to preparation procedure). Upper dentition: all teeth fully erupted; both I^1 and canines are not present *in situ*; M^2, M^3 (S) and P^4, M^2, M^3 (D) are present *in situ*, and both M^3 do not show any degree of wear, P^4 (D) shows heavy wear. Lower dentition: all teeth fully erupted; all I_2 and I_3 are not present *in situ*, but the alveolus of I_2 (S) also absent; P_1, P_3, M_2, M_3 (S) and P_3, M_3 (D) are present *in situ*, and both M_3 show only a little wear. All isolated incisors and canines are preserved, but not all the isolated molariforms (only five isolated teeth in total are preserved). **O**: *Tapirus indicus*, ♀, Prague Zoo, 17 September 1990; a.n. 52/1990. **N**: *Tapirus indicus*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear: max. 8 years according to Maffei (2003). However, the animal was actually 26 years old according to the zoo evidence (for discussion see below). Indication of traction epiphyses of the lachrymal tubercle is present (Cave 1965). The hind rear of the nasal bone (D) is fractured and healed. The nasal septum seems to be ossified completely (cf. Pocock 1945b in Asiatic rhinoceroses). Data on the invidual from the Prague Zoo: ♀ named Isolda (nickname Sosina), captive born on 10 April 1964 (Nuremberg Zoo), died on 27 August 1990 (Prague Zoo, weight 309 kg, actinomycosis), Studbook No. 61 (ARKS 900042).

NMP 47213; well preserved skull with mandible, hyoid bones, and the axis vertebra. Upper dentition: all teeth fully erupted; both M^3 do not show any degree of wear. Lower dentition: all teeth erupted; both M_3 show only minute traces of wear. The P_1 (S) and P_2 (D) are not present *in situ* and preserved as isolated teeth. The individual lacks one pair of lower incisors, probably due to the oligodonty, as no traces of alveoli are detectable. **O**: *Tapirus indicus*, ♂, Prague Zoo; a.n. 33/94 [osteology 461]. **N**: *Tapirus indicus*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear: 6–8 years according to Maffei (2003). However, the animal was actually 21 years according to the zoo evidence (for discussion see below). Data on the individual from the Prague Zoo: ♂ named Lotos (nickname Béďa), captive born on 3 July 1972 (Stuttgart Zoo), died on 25 January 1994 (Prague Zoo, phlegmona), Studbook No. 163 (ARKS 900001).

NMP 93437; well preserved skull with mandible. The posterior part of the mandible (S) (*ramus mandibulae*) is pathologically deformed and extensively perforated (Fig. 2; for details see discussion below). Upper dentition: all incisors and canines erupted; the I^1 (D) broken and C (D) absent; only five molariforms fully erupted; both M^2 erupted, but not in occlusion; both M^3 in evidence and not erupted. Lower dentition: all incisors and canines erupted; I_3 (D) absent; only four molariforms present; both M^2 erupted, but not in occlusion; both M_3 in evidence, but not erupted. **O**: *Tapirus indicus*, ♀, Dvůr Králové Zoo; DK 38, 01/94/2. **N**: *Tapirus indicus*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear: less than two years according to Maffei (2003), however, the individual was approximately 5–6 years old acording to

Table 1. Measurements of tapir skulls (in mm), taken according to Simpson (1945), von Driesch (1976), Padilla & Dowler (1994), and du Toit (1987a). Two values under one dimension (X/Y) are associated with left and right side, respectively. Abbreviations: t. – taxon; *i* – *Tapirus indicus*; *t* – *Tapirus terrestris*. For the dimension acronyms see Abbreviations, p. 240

Tab. 1. Lebeční rozměry revidovaných tapírů (v mm) měřených dle Simpsona (1945), von Driesche (1976), Padilly & Dowlera (1994), a du Toita (1987a). Dva číselné údaje u jednoho rozměru (X/Y) se vztahují k levé a pravé straně. Zkratky: a. – přibližně; *i* – tapír čabrakový; *t* – tapír jihoamerický. Zkratky rozměrů viz Abbreviation, str. 240

No.	t.	LCb	LB	AO	LaNc	LO	LaM	LaZ	LaI	BO	PC	PMs	LN	LaN	LPN	LF	LaCO	LMd	ACr	ACn	PMi
NMP 9897	*i*	~430	–	–	–	~77	–	–	–	–	–	–/140	~115	~83	~184	~208	~90	~385	–/~199	–/~156	~125
NMP 10799	*t*	–	357	115	102	62	112	–	66	10	–	145/145	~78	76	148	167/168	–	325/325	–/165	127/125	132/132
NMP 24764	*t*	~191	~181	–	74	~35	64	102	52	11	13	65/64	51	29	52	79/80	52	165/165	78/77	57/57	73/74
NMP 25961	*i*	440	422	95	116	82	137	221	93	8	18	147/148	~111	96	197	199	90	376/381	210/212	168/172	133/133
NMP 46077	*t*	~410	393	98	96	71	118	188	67	15	–	143/144	93	80	164	176/174	–	350/350	–	134/134	131/134
NMP 46078	*t*	381	367	88	96	57	103	181	71	11	11	129/130	88	77	154	168/174	70	331/334	177/178	149/146	119/119
NMP 46459	*i*	450	445	90	118	85	147	235	89	10	16	–	147	103	170	213	101	407/416	211/215	169/170	~163/–
NMP 47213	*i*	437	420	87	114	78	135	220	89	19	20	164/160	101	92	203	202	91	377/378	198/194	157/159	–/~144
NMP 90114	*t*	371	352	86	96	73	104	185	66	11	12	140/141	101	79	135	163/165	82	318/320	161/–	127/129	126/127
NMP 90115	*t*	368	353	116	98	–	116	178	63	–	15	101/101	~72	80	156	158/158	78	311/315	–/165	130/132	91/91
NMP 90116	*t*	–	–	–	96	58	–	169	67	15	–	95/96	–	–	–	161	–	~301	–	127/126	–/84
NMP 93437	*i*	414	397	92	111	79	137	205	88	15	21	113/113	113	95	191	191	91	350/343	198/180	159/148	99/98
NMP 93438	*t*	–	368	98	100	–	120	178	72	–	–	134/135	~89	75	156	168	–	316/323	177/175	123/128	130/129
NMP 93439	*t*	–	~356	–	99	–	116	183	68	–	–	105/99	~100	~74	~134	166/168	–	315/318	165/165	125/133	92/92
NMP 93440	*t*	370	351	103	97	62	116	181	62	5	15	135/136	80	75	152	159/162	87	312/319	170/170	127/130	126/128
NMP 93441	*t*	325	308	~103	91	57	99	155	61	8	16	94/92	67	63	132	144	66	276/277	149/149	~110/108	84/–
NMP 93442	*t*	378	355	108	94	62	109	177	64	8	15	99/99	91	77	144	164/165	83	312/319	–/162	122/124	87/87
NMP 93443	*t*	–	–	–	–	–	–	174	62	–	–	125/126	53	75	157	166/167	–	318/318	149/150	111/112	117/117
NMP 93444	*t*	397	379	120	97	65	123	177	66	12	18	95/96	81	76	–	174/176	87	326/326	168/171	120/125	85/85
NMP 93445	*t*	375	359	102	97	60	114	172	67	16	17	96/96	92	77	149	158/161	82	311/313	164/165	126/126	~86/~87

Table 1. (continued)
Tab. 1. (pokračování)

No.	t.	LCb	LB	AO	LaNc	LaO	LaM	LaZ	LaI	BO	PC	PMs	LN	LaN	LPN	LF	LaCO	LMd	ACr	ACn	PMi
NMP 93446	*t*	398	380	111	93	69	121	179	65	8	17	131/132	110	75	149	183/184	80	335/330	181/182	142/142	121/122
NMP 93447	*t*	383	371	100	87	58	111	175	58	10	13	~82	93	73	145	167/ 166	83	310/314	162/160	120/118	89/88
NMP 93448	*t*	–	–	–	99	~60	–	154	64	–	15	99/99	~76	~70	–	141/141	76	282/281	153/150	114/117	87/86
NMP 93449	*t*	392	375	106	85	64	113	189	60	7	17	137/138	~69	74	~170	171/170	86	327/327	169/169	128/129	128/128
NMP 93450	*t*	–	380	119	~94	70	128	178	62	9	–	119/118	–	–	–	178/177	–	322/321	175/175	143/144	110/110
NMP 93451	*t*	–	–	–	95	63	–	163	62	–	–	99/100	–	–	–	–/147	–	283/283	~156/159	119/118	90/81
NMP 93452	*t*	–	–	–	91	–	116	173	64	–	–	98/99	–	–	–	168	–	–	–	–	–
NMP 93453	*t*	–	–	–	95	59	–	165	63	19	18	94/94	~85	76	157	169/165	84	311/312	164/165	126/128	83/83
NMP 93454	*t*	–	–	–	104	–	–	182	73	–	–	120/121	~89	~74	–	71/69	–	312/315	162/162	129/127	108/108
NMP 93455	*t*	–	–	–	99	64	~113	186	65	–	–	101/102	90	64	140	156/157	–	292	166/164	123/122	~90/~90
NMP 93456	*t*	391	375	115	97	68	115	182	59	18	–	140/140	103	80	148	179/179	76	323	176/173	140/140	131/131
NMP 93457	*t*	–	–	–	–	–	–	185	~58	–	–	127/128	87	72	158	–	–	319	164/164	133/132	164/166
NMP 93458	*t*	–	365	111	95	–	115	178	64	–	–	144/145	94	74	151	170/168	–	315	166/174	139/139	134/136
NMP 93459	*t*	–	–	–	~92	~64	–	167	67	~7	18	79/80	~78	~62	–	148	85	286/289	152/154	112/113	88/88
NMP 93460	*t*	–	–	–	–	–	–	178	–	–	–	100/100	93	78	–	168	87	–	–	–	–
NMP 93461	*t*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	304/307	170/168	129/132	88/87
IAMF 226	*t*	~408	–	~130	102	69	130	186	66	17	19	138/139	~97	78	161	178/179	89	347/344	182/181	~139/138	127/128
ISZ OM-84	*t*	371	356	102	101	62	109	175	67	12	17	99/100	78	58	142	158/160	80	304/302	157/158	121/120	90/–
ZMP unn.	*i*	–	394	87	97	81	126	203	79	16	–	140/139	111	86	186	192/191	–	369/369	186/186	142/142	128/127
ZMP unn.	*t*	399	381	119	78	86	117	211	67	7	15	132/131	87	70	160	175/171	77	346/337	181/182	145/143	125/123

the zoo evidence (for discussion see below). Indication of traction epiphyses of the lachrymal tubercle is present (Cave 1965). Data on the individual from the Dvůr Králové Zoo: date of death – 21 February 1977.

NMP 9897; complete mounted skeleton, well preserved (currently placed in the permanent NMP exhibition). Upper dentition (based only on the examination of the right side from lateral view): all incisors and canines erupted, only six molariforms fully erupted; M^3 not erupted (i.e. not visible from the lateral view). Lower dentition (based only on the examination of the right side from lateral view): all incisors and canines erupted, only five molariforms fully erupted; M_3 not erupted (i.e. not visible from the lateral view). **O**: *Tapirus indicus*. **N**: *Tapirus indicus*. Skull sutures closed (lateral view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. We obtained only some measurements and observations due to the montage of the skeleton in the permanent exhibition. This skeleton is probably associated with the dermoplastic specimen NMP 9896 in the exposition (see below). If so, the gravid status of this female could be surprising in contrast with the dental eruption, but the eruption could be retarded in this individual or it could not meet with sexual maturity accurately (compare for example time of adulthood according to dental eruption and the earliest known ages at which conception occurred in *Tapirus terrestris* – Padilla & Dowler 1994 and Maffei 2003).

ZMP unnumbered; well preserved skull with mandible, cut occipital condyls, and I_3 (D) absent. Upper dentition: all incisors and canines erupted; six molariforms fully erupted; both M^3 in evidence, erupted from the mandible. Lower dentition: all incisors and canines erupted, four molariforms fully erupted; both M_3 in evidence, erupted from the mandible. **O**: *Tapirus indicus*, unknown. **N**: *Tapirus indicus*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. The nasal septum right inclined, it seems to be ossified completely (see Pocock 1945b in Asiatic rhinoceroses).

Tapirus terrestris (Linnaeus, 1758)

Four subspecies of *T. terrestris* are currently recognised and their definition is based on body size, pelage coloration and geographical distribution (Hershkovitz 1954, Padilla & Dowler 1994, Grubb 2005); viz., *T. t. terrestris* (Linnaeus, 1758), *T. t. aenigmaticus* Gray, 1872, *T. t. spegazzinii* Ameghino, 1909, and *T. t. colombianus* Hershkovitz, 1954. We were not able to determine subspecific status of the specimens, especially for the absence of any evidence of their geographical origin in most of the items. However, none of the examined specimens had the typical skull characters of *T. t. spegazzinii* described by Ameghino (1909), the remaining three forms are thus in consideration.

NMP 12777; well preserved skin of a juvenile specimen with striped coloration. **O**: *Tapirus terrestris*, Brazil, Paraná, 1941, donated by J. Potůček; a.n. 47/73. [Potůček was a Czechoslovak consul in Paraguay; Štěpánek 1975: 109]. **N**: the known geographical origin of the specimen supports the species identification

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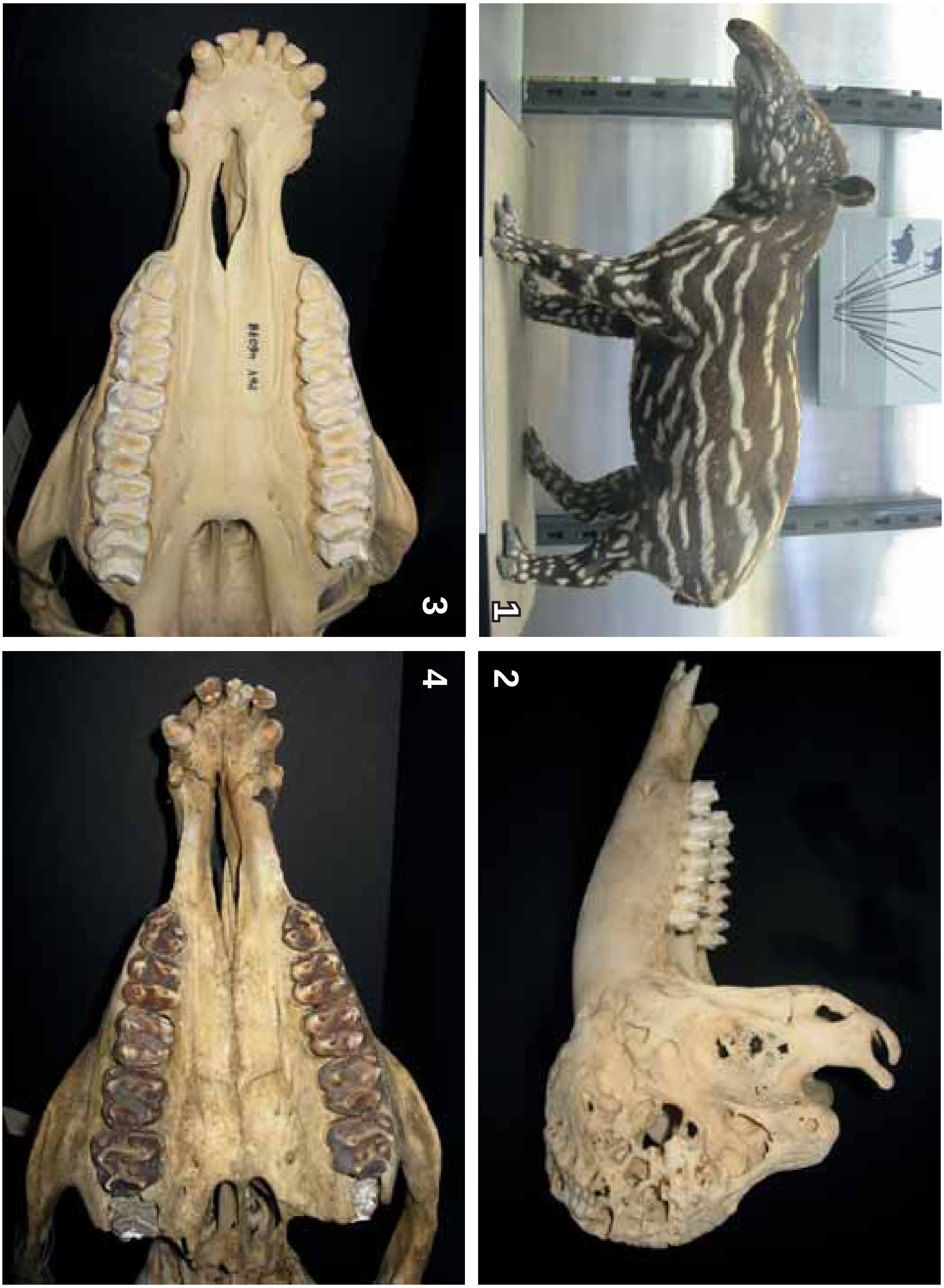
Figs. 1–4. Tapir specimens from the NMP collection. 1 – *Tapirus indicus*, s.i.; NMP 9898. Mounted specimen of a juvenile. 2 – *Tapirus indicus*, ♀; NMP 93437. Lateral view of the mandible; note the deformations in the ramus, probably due to actinomycosis. 3 – *Tapirus terrestris*, ♀; NMP 46078. Ventral view of the skull; note the asymmetry in the upper incisor and canine positions – the right canine is shifted more backwards. 4 – *Tapirus terrestris*, s.i.; NMP 90115. Ventral view of the skull; note the different shapes of the first incisors.
Obr. 1–4. Exempláře tapírů ze sbírky Národního musea v Praze. 1 – boční pohled na kůži mláděte tapíra čabrakového (NMP 9898). 2 – boční pohled na pathologicky výrazně znetvořenou dolní čelist samice tapíra čabrakového (NMP 93437), pravděpodobně kvůli aktinomykose. 3 – spodní pohled na lebku samice tapíra jihoamerického (NMP 46078) s asymetrií řezáků a špičáků. 4 – spodní pohled na lebku tapíra jihamerického (NMP 90115) s odlišným tvarem prvních řezáků.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and enables us to identify it as *T. t. terrestris* or *T. t. spegazzinii*. Age estimation: juvenile of the age of less than 51 days according to Adachi (2004).

NMP 9899; mounted skin with striped coloration (currently placed in the permanent NMP exhibition). **O**: *Tapirus terrestris*, juvenile, purchased from the Frič company for 25 guldens; 21/1894. **N**: age estimation: juvenile of the age of less than 51 days according to Adachi (2004). The coloration is faded, probably due to the long-time exposition to day light.

NMP 10799; poorly preserved skull with mandible (currently placed in the permanent NMP exhibition); occipital condyles cut out, the left zygomatic arch incomplete, the distal part of the left coronoid process of mandible broken, horizontal cracks present in lower incisors and canines, I^3 (D) absent. All upper and lower teeth fully erupted; both M^3 with advanced wear, both M_3 with a little wear. **O**: *Tapirus terrestris*. No. 15 on the mandible. **N**: *Tapirus terrestris*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 6 years.

NMP 46077; poorly preserved skull with mandible, both coronoid processes of mandible broken. Upper and lower dentition: all teeth fully erupted; both M^3 and M_3 do not show any degree of wear; all incisors and canines absent. **O**: *Tapirus terrestris*, coll. V. Frič; a.n. 14/60 2909, osteology 555; No. 27 on the skull. **N**: *Tapirus terrestris*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 6 years.

NMP 46078; well preserved disarticulated skeleton, almost complete – postcranial skeleton composed of sacrum, lumbal vertebrae, patellae, scapulae, pelvis, and long bones of extremities. Upper dentition: all teeth fully erupted; both M^3 and M_3 do not show any traces of wear. An additional alveolus is present behind the upper canine (S) and the canine is shifted forward in comparison with the opposite (D) side of the skull (and normal condition in tapir skulls) (Fig. 3). The lower I_3 (S) is absent. **O**: *Tapirus terrestris*, ♀; a.n. 7709. **N**: *Tapirus terrestris*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 6 years. However, the animal was actually at least 7 years old according to the zoo evidence (for discussion see below). Data on the individual from the Prague Zoo: ♀, wild born – obtained from the Behrend Zoo on 29 September 1950, died on 11 August 1957 (Prague Zoo, degeneration of liver parenchyme, heart myodegeneration).

NMP 90114; poorly preserved skull with mandible, with the right coronoid process broken. Upper and lower dentition: all teeth fully erupted; both M^3 do not show any traces of wear; I^1, I^2 and canine (S) absent. Lower dentition: all incisors and canines erupted, but only five molariforms fully erupted; both M_3 erupted, near to occlusion; I_1 (S) and I_2 (S) absent. **O**: *Tapirus* sp. **N**: *Tapirus terrestris*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 4 years.

NMP 90115; poorly preserved skull with mandible, with the occipital region cracked, the posterior ridges of the braincase (occipital crests), the apex of the left coronoid process and the palatum behind the second molar are broken. Upper dentition: all incisors and canines fully erupted; I^2 (D) absent. Five molariforms fully erupted, both M^2 erupted, but not in occlusion; conditions for M^3 is unknown due to the palate damage. Lower dentition: only a trace of one left alveolus (probably for I_3) and two right alveoli (probably for I_2 and I_3) detected; both canines and four molariforms fully erupted; both M_2 in evidence, but not erupted from the mandible; both M_3 in evidence, but not erupting from the mandible. **O**: *Tapirus* sp., subadult;

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Figs. 5–8. *Ceratotherium cottoni*, specimens in the NMP collection. Ventral views of the skull, upper dentitions. 5 – ♀ Nasima; NMP 47145. 6 – ♂ Ben; NMP 93510. 7 – ♀ Nuri; NMP 93511. 8 – ♂ Saut; NMP 93512.

Obr. 5–8. Spodní pohled na dentici nosorožců Cottonových sbírky Národního musea v Praze. 5 – dospělá samice Nasima (NMP 47145). 6 – starý samec Ben (NMP 93510). 7 – mladá samice Nuri (NMP 93511). 8 – starý samec Saut (NMP 93512).

a.n. *sine*; No. 17 on the mandible. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. Indication of traction epiphyses of the lachrymal tubercle (cf. Cave 1965) is preserved. I^1 (S) atypical in its shape, being bilobed (Fig. 4).

NMP 90116; poorly preserved skull with mandible; three holes from bullets on the left side of the braincase, basioccipital region broken and not preserved, all molariforms covered by a paper slip, distal half of the left nasal bone broken and the whole right nasal bone broken, and several breakages in the posterior part of mandible. Upper dentition: all incisors and canines erupted, but only I^3 (D) is present *in situ*; five molariforms fully erupted; both M^2 erupted from the mandible, but not in occlusion; both M^3 are not in evidence. Lower dentition: all incisors and canines erupted, I_1 and I_2 (S) and I_1–I_3 (D) absent; four molariforms fully erupted, but P_1 (D) absent; P_2 (S) erupted, but not in occlusion; both M_2 in evidence, erupted from the mandible; both M_3 in evidence, but not erupted from the mandible. **O**: *Tapirus* sp., subadult; No. 22 on the mandible. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. Traction epiphyses of the lachrymal tubercle (cf. Cave 1965) are visible. Teeth replacements well observable.

NMP 93438; poorly preserved skull with mandible; right posterior ridge of the braincase (occipital crest) and both occipital condyles are cut out, left coronid process of the mandible is partly broken on its dorsal edge. Upper dentition: all incisors and canines erupted, but I^1, I^2 (S) and I^1 (D) and both canines absent; six molariforms fully erupted; both M^3 erupted, but not in occlusion. Lower dentition: all teeth fully erupted; one canine (D) is evidently smaller (half-sized) and shifted backward than the left one; a small gap behind the I_3 (D) is present. **O**: absent. **N**: many characters suggest the identification as *T. terrestris*, although a relatively very wide sagittal crest is present in the specimen. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 2–4 years.

NMP 93439; poorly preserved skull with mandible; both posterior ridges of the braincase (occipital crest) and both occipital condyles are cut out; one bullet is present in the middle portion of *ramus mandibulae* (S); one relatively large aperture is present below the right condylar process (probably due to a bullet). Upper dentition: all incisors and canines fully erupted, but absent; five molariforms fully erupted; P^3 (D) erupted, but not in occlusion; both M^2 in evidence, but not fully erupted; no traces of any M^3. Lower dentition: all incisors and canines fully erupted, but absent; four molariforms fully erupted; both M_2 in evidence, not erupted; both M_3 almost not in evidence. **O**: No. 28 on the skull. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. Traction epiphyses of the lachrymal tubercle are visible.

NMP 93440; well preserved skull with mandible, one auditory bulla (S) and some teeth are absent. Upper and lower dentition: all teeth fully erupted; all M^3 and M_3 not or very little weared. The I^1 (D) absent, I_1, I_2 (S) and I_1 (D) broken. **O**: No. 16 on the skull. N: *Tapirus terrestris*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 4–6 years.

NMP 93441; well preserved complete skeleton, partly mounted (backbone, forelimbs, hind limbs); a hole above the right orbit is present (probably from a bullet), some teeth are not present *in situ*. Upper dentition: all incisors and canines fully erupted; but only five molariforms fully erupted; both M^2 partly in evidence, not erupted; both M^3 not in evidence. Lower dentition: all incisors and canines erupted; only four molariforms fully erupted; ; both I_3 absent; both M_2 partly in evidence, not erupted; both M_3 not in evidence. The P_1, P_2 (D) absent. **O**: OM-292, no. 8091; donated by the Department of Zoology, Charles University. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. Incompletely fused epiphyses also indicate an immature individual. Nasal septum well preserved. Indication of traction epiphyses of the lachrymal tubercle (cf. Cave 1965) is present.

NMP 93442; well preserved complete skeleton; basioccipital region of the skull broken, but preserved. Upper dentition: all incisors and canines fully erupted, but only five molariforms fully erupted; both M^2 in evidence, but not fully erupted from the maxilla; both M^3 not in evidence; one canine (D) absent. Lower dentition: all incisors and canines fully erupted, but only four molariforms fully erupted; both M_2

in evidence, but not erupted; both M_3 in a partial evidence, not erupted. **O**: Frič 1. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years.

NMP 93443; skull with mandible, dentition well preserved, a half of the braincase cut out, nasal bones are cracked on the distal ends and deformed. Upper and lower dentition: all teeth fully erupted; both M^3 and M_3 with advanced wear. **O**: Frič 3. **N**: *Tapirus terrestris*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 12 years or more.

NMP 93444; complete disarticulated skeleton, with a poorly preserved skull; nasal bones of the skull and the right auditory bulla broken, some teeth are absent. Upper dentition: all incisors and canines fully erupted, but only five molariforms fully erupted; both M^2 probably fully erupted (but the teeth absent); both M^3 not in evidence; the I^1 (S) absent. Lower dentition: all incisors and canines fully erupted, but only four molariforms fully erupted; both M_2 probably erupted, but absent; both M_3 in a partial evidence, but not erupted from the mandible. **O**: Frič 4. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. Traction epiphyses of the lachrymal tubercle (cf. Cave 1965) are well detectable. Premaxillae in some respects similar to *T. bairdii*, but other characters clearly suggest identification as *T. terrestris*.

NMP 93445; well preserved skull with mandible. Upper dentition: all incisors and canines fully erupted, but only five molariforms fully erupted; both M^2 in evidence, but not erupted; both M^3 not in evidence; almost all incisors and canines absent, except for I^2 and I^3 (S). Lower dentition: all incisors and canines fully erupted, but only four molariforms fully erupted (except for P_2 (S) – erupted, but not in occlusion to other molariforms); both M_2 and M_3 partly in evidence, but not erupted from the mandible; only I_1 (both sides) and one canine (S) present. **O**: Frič 5. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view); the basilar suture also remains open. Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. Traction epiphyses of the lachrymal tubercle (cf. Cave 1965) are present. One long and narrow (probably erupted) tooth is observable on the inner surface of mandibular symphysis – an identical tooth morphology and position was figured for I_3 by Ameghino (1911: Fig. 14).

NMP 93446; well preserved skull with mandible, one auditory bulla (D) broken; three upper incisors (both I^1 and right I^2) and one upper canine (S) are not present *in situ*, but are preserved as isolated teeth. Upper and lower dentition: all teeth fully erupted; both I_3 seem to be absent; all M^3 and M_3 with advanced wear. **O**: No. 19 on the skull. Frič 6. **N**: *Tapirus terrestris*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 12 years or more.

NMP 93447; poorly preserved skull with mandible; five holes from bullets are present on the left side of the skull, at least one on the right side of the skull, and three other holes on the left *ramus mandibulae*. Upper dentition: all incisors and canines fully erupted, only five molariforms are fully erupted; both M^2 erupted, but not in occlusion; both M^3 not in evidence; both I^1, the I^2 and C (S) and both P^1 absent. Lower dentition: all incisors and canines fully erupted; but only four molariforms fully erupted; both M_2 erupted; both M_3 partly in evidence, not erupted. **O**: No.?13 on the skull; Frič 7. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. The distal rest of nasal septum is preserved.

NMP 93448; poorly preserved skull with mandible; nasal bones, both auditory bullae, and basioccipital region broken, eight teeth, some deciduous, are not present *in situ*, but these teeth are preserved. Upper dentition: teeth replacements are well observable in incisors and canines – six deciduous or permanent incisors + canines and six alveoli are observable; five molariforms fully erupted; both M^2 partly in evidence, not erupted; both M^3 not in evidence. Lower dentition: teeth replacements are observable in incisors and canines, but the rostral portion of mandible is partly destroyed and does not enable a precise description; four molariforms fully erupted; both M_2 partly in evidence, but not erupting; both M_3 not in evidence. **O**: Frič 7AB. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years.

NMP 93449; well preserved skull with mandible, dorsal edge of the right zygomatic arch is broken. Upper and lower dentition: all teeth fully erupted; both I^1, I^2, one upper canine (D), and I_2 (S) incisor absent; both M^3 and M_3 with a little wear. **O**: Frič 8. **N**: *Tapirus terrestris*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 12 years and more.

NMP 93450; poorly preserved skull with mandible, nasal bones are cut in their halves, and occipital condyles are cut out. Upper dentition: all incisors and canines fully erupted; six molariforms fully erupted; both M^3 partly in evidence, not erupted; all upper incisors and canines absent. Lower dentition: all incisors and canines fully erupted; five molariforms fully erupted; both M_3 partly in evidence, not erupted; all lower incisors and canines absent. **O**: Frič 9. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years.

NMP 93451; poorly preserved skull with mandible, nasal bones absent and the basioccipital region broken, but preserved. Upper dentition: teeth replacements in incisors and canines are partly observable, but the rostral position of the premaxilla is partly destroyed and does not enable a precise description – two permanent (I^1 or I^2?) teeth in evidence; five molariforms fully erupted; both M^2 partly in evidence, but not erupted; both M^3 not in evidence. Lower molars: teeth replacements in incisors and canines observable – six alveoli for deciduous and ten for permanent teeth are present; first permanent incisors probably in evidence; four molariforms fully erupted; both M_2 partly in evidence, but not erupted; both M_3 not in evidence. **O**: Frič 10. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. Traction epiphyses of the lachrymal tubercle (cf. Cave 1965) well detectable.

NMP 93452; poorly preserved skull without mandible, occipital condyles are cut out and nasal bones absent. Upper dentition: all incisors and canines erupted, but only both I^3 present *in situ*; five molariforms fully erupted; both M^2 erupted, but not in occlusion; both M^3 not in evidence. **O**: Frič 12. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. The specimen exhibits a relatively wide sagittal crest, but in lesser degree than NMP 93438. However, many other characters suggest the identification as *T. terrestris*.

NMP 93453; well preserved skull with mandible, the basioccipital region is broken, but preserved; 13 isolated teeth are preserved. Upper dentition: all incisors and canines erupted, but not present *in situ*. Five molariforms fully erupted; both M^2 in evidence, but not erupted; both M^3 not in evidence. Lower dentition: all incisors and canines fully erupted, but only I^1 (S) and C (S) present; four molariforms fully erupted; both M^2 partly in evidence, partly erupted; both M^3 partly in evidence, not erupted. **O**: *Tapirus americanus*; L=40 cm; accession date: 12 September 1908; no. 14. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. Indication of traction epiphyses of the lachrymal tubercle (cf. Cave 1965) is present.

NMP 93454; poorly preserved skull with mandible, the basioccipital region is cut out, nasal bones are broken, but preserved; eight isolated teeth are present. Upper dentition: all incisors and canines erupted, but only C (D) and erupted I^3 (D) are present; six molariforms fully erupted; both M^3 only partly in evidence. Lower dentition: all incisors and canines fully erupted, but only canines present; five molariforms fully erupted; both M_3 partly in evidence, but not erupted. **O**: 1912; Frič 15. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. The specimen exhibits a relatively wide sagittal crest, but in lesser degree than NMP 93438. However, many other characters suggest the identification as *T. terrestris*.

NMP 93455; poorly preserved skull with mandible, occipital bones broken, not preserved, both auditory bullae broken and preserved, 11 teeth not present *in situ*, but preserved; one zygomatic arch (D) broken. Upper dentition: teeth replacements are well observable in incisors and canines – four deciduous or permanent incisors and canines, and four alveoli are observable; five molariforms fully erupted; both M^2 partly in evidence, not erupted; both M^3 not in evidence. Lower dentition: teeth replacements are

observable in incisors and canines – six alveoli for incisors and two pairs of canines (one very small and one in normal size); four molariforms fully erupted; both M_2 partly in evidence, but not erupted; both M_3 partly in evidence, not erupted. **O**: Frič 17. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years.

NMP 93456; well preserved skull with mandible, two upper teeth absent; horizontal cracks in upper and lower incisors and canines are visible. Upper and lower dentition: all teeth fully erupted; both M^3 and M_3 show a little wear; I^1 (D), C (S) and I_3 (S) not *in situ*, and also not preserved except for I_3. **O**: No. 18 on the skull. **N**: *Tapirus terrestris*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 6 years.

NMP 93457; poorly preserved skull with mandible, the dorsal third of the braincase cut out, inner surface of the left orbit broken; only six isolated incisors and canines are preserved, but not present *in situ*. Upper and lower dentition: all teeth fully erupted; M^3 and M_3 show an advanced wear; incisors and canines are not present *in situ* except for I^3 (S), only 6 from 15 are preserved; P^1 (D) and P_2–P_4 (D) are not present *in situ*, but preserved. **O**: No. 21 on the skull. **N**: *Tapirus terrestris*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 6–8 years. Indication of traction epiphyses of the lachrymal tubercle (cf. Cave 1965) is present.

NMP 93458; poorly preserved skull with mandible, both posterior ridges of the braincase (occipital crests) and both occipital condyles are cut out, both auditory bullae broken; distal end of the zygomatic arch (S) cut out; coronoid and condylar processes (S) of the mandible partly broken or cut out. All teeth perfectly preserved; horizontal cracks in upper and lower incisors and canines present. Upper and lower dentiton: all teeth fully erupted; both M^3 and M_3 show no or a little wear. **O**: F 2/2 / CHB. **N**: *Tapirus terrestris*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 4 years. Indication of traction epiphyses of the lachrymal tubercle (cf. Cave 1965) is present.

NMP 93459; well preserved skull with mandible, the basioccipital region and nasal bones are broken, but preserved; 15 isolated teeth preserved. Upper dentition: teeth replacements in incisors and canines partly observable based on the alveoli number (16), all incisors and canines seem to be erupted, but not present *in situ*; four molariforms fully erupted; both M^1 erupted, but not in occlusion; both M^2 only partly in evidence, not erupted; both M^3 not in evidence. Lower dentition: teeth replacements in incisors and canines are partly observable, but the rostral portion of mandible is partly destroyed and does not enable a precise description; probably permanent I_1 (S) in evidence; thee molariforms fully erupted; both M_1 erupted, in occlusion; both M_2 only partly in evidence, not erupted; both M_3 not in evidence. **O**: Frič 23. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years.

IAMF 226; well preserved skull with mandible mounted together. A hole (perhaps) associable with a bullet is located on the right side of the braincase above the auditory region. Upper dentition: all incisors and canines erupted; six molariforms fully erupted; both M^3 erupted, but not in occlusion. Lower dentition: all incisors and canines erupted; five molariforms fully erupted; both M_3 erupted, but not in occlusion. **O**: 226; No. 373 on the skull. **N**: *Tapirus terrestris.* Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): two years. Indication of traction epiphyses of the lachrymal tubercle (cf. Cave 1965) is present.

ISZ OM-84; well preserved skull with mandible. Upper dentition: teeth replacements in incisors and canines partly observable – two alveoli and 10 incisors and canines are present; five molariforms fully erupted; both M^2 in evidence, but not erupted; both M^3 not in evidence. Lower dentition: teeth replacements in incisors and canines partly observable, but the rostral portion on the left half of the mandible is partly destroyed and does not enable a precise description; I_1 (S) and I_1–I_3 (D) present; four molariforms fully erupted; P_1 (D) absent; both M_2 and M_3 partly in evidence, but not erupted. **O**: OM-84. **N**: *Tapirus terrestris*. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): less than two years.

ZMP unnumbered; well preserved skull with mandible. Posterior edge of the mandible (D) lingually inclined, probably due to former fracture and secondary healing in this position; one small bone bulge on the posterior edge of the mandibular symphysis. Upper and lower dentition: all teeth fully erupted; both M^3 and M_3 show no or little wear; I^1 and I^2 (D) broken and lower incisors and canines abraded. **O**: *Tapirus terrestris*, unknown. **N**: *Tapirus terrestris*. Skull sutures closed (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): 4 years.

Tapirus cf. *terrestris* (Linnaeus, 1758)

NMP 24764; well preserved complete juvenile skeleton with many preserved articulations; premaxillae partly mobile, nasal crest absent; nasal septum translucent; sternal elements not completely fused. Upper dentition: all incisors erupted; canines not erupted, but signs of eruption of a canine (D) present; three molariforms are fully erupted, both P^4 premolars erupted, but not in occlusion; both M^1 partly in evidence; $M^{2–3}$ not observable. Lower dentition: all incisors and canines erupted, except for the I_3 (D); three molariforms are fully erupted; both M_1 in evidence, but not erupted; $M_{2–3}$ not observable. Upper and lower molariforms partly cracked. **O**: old tag: *Tapirus americanus*, ♂, 1003, 73.22, South America. Naturalien, Museum, J. F. G. Umlauff, Hamburg, Spielbudenplatz N. 8. New tag: juvenile, 9 March 1922, coll. V. Frič; a.n. 14/60 2721. **N**: we are not able to verify the species identification due to the juvenile age of the individual; we tend to accept the original identification. Age estimation based on teeth eruption and wear (Maffei 2003): less than two years. Juvenile growth is also supported by unfused epiphyses of long bones, open skull sutures and dental eruption. Sternum and pelvis formation, and signs of traction epiphyses of the lachrymal tubercle are perfectly observable.

NMP 93460; poorly preserved skull without mandible, nasal bones and braincase broken, but preserved. Upper dentition: all incisors and canines erupted, but only both I^3 present *in situ*; five molariforms fully erupted; both M^2 erupted, but not in occlusion; both M^3 not in evidence. **O**: Frič 11. **N**: *Tapirus* cf. *terrestris* – species identification based on dental morphology, crest region (albeit incomplete) and the premaxillae shapes. Skull sutures open (dorsal view). Age estimation based on teeth eruption and wear (Maffei 2003): two years.

NMP 93461; well preserved mandible. Lower dentition: teeth replacements in incisors and canines observable – altogether seven teeth and three alveoli are present; four molariforms fully erupted; both M_2 partly in evidence, not erupted; both M_3 not in evidence. **O**: Frič 13. **N**: *Tapirus* cf. *terrestris*. Age estimation based on teeth eruption and wear (Maffei 2003): less than two years.

NMP 93462; almost complete disarticulated postcranial skeleton with vertebrae, hyoid bones, pelvis, ribs, sternum, scapulae, limb bones, but without autopodia. **O**: *Tapirus terrestris* (*americanus*), Kludský. **N**: *Tapirus* cf. *terrestris*; we are not able to give an exact species identification, but we tend to accept the original identification. Completely fused epiphyses indicate a mature individual. The specimen most probably originated from the Kludský Circus.

IAMF D16/65, C16/66; well preserved complete mounted skeletons of left extremities, including scapula. **O**: *Tapirus americanus*, D16/65, D16/66; a label on the forelimb: n. 20. **N**: *Tapirus* cf. *terrestris*; we are not able to give exact species identification, but we tend to accept the original identification. Completely fused epiphyses indicate a mature individual.

Tapirus Brisson, 1762 sp.

NMP 93463; poorly preserved, almost complete left posterior autopodium and dissociated crus. Only distal parts (thirds) of the fibula and tibia are preserved. **O**: *Tapirus*, No. 29, Frič. **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93464; well preserved complete left posterior autopodium and crus. **O**: *Tapirus*, No. 30, Frič. **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93465; well preserved complete left hind limb, fibula dissociated from tibia. **O**: *Tapirus*, No. 32, Frič, "zadní pravá ke koleni" (= right hind [limb from the foot] to the knee). **N**: *Tapirus* sp., we are not able to provide exact species identification. Incompletely fused epiphyses indicate an immature individual.

NMP 93466; poorly preserved complete ?left anterior autopodium. **O**: *Tapirus*, No. 35, Frič. **N**: *Tapirus* sp., we are not able to provide exact species identification. Incompletely fused epiphyses indicate an immature individual.

NMP 93467; well preserved right femur. **O**: *Tapirus* sp., No. 42, 1905, "zadní pravá" (= right hind [limb]). **N**: *Tapirus* sp., we are not able to provide exact species identification. Fused epiphyses indicate a mature individual.

NMP 93468; well preserved left tibia associated with fibula. **O**: *Tapirus* sp., No. 43, V. Frič, tibia and fibula, l. sin. **N**: *Tapirus* sp., we are not able to provide exact species identification. Fused epiphyses indicate a mature individual.

NMP 93469; well preserved complete skeletons of posterior autopodia. **O**: *Tapirus* sp., No. 43, V. Frič, "zadní pravá – část" (= right hind [limb] – part). **N**: *Tapirus* sp., we are not able to provide exact species identification.

NMP 93470; well preserved complete right anterior forelimb without scapula. **O**: *Tapirus*, No. 50, Frič, tarsus, "přední pravá končetina" (= right forelimb). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93471; well preserved complete left anterior forelimb including scapula, but without autopodium, ulna dissociated from radius. **O**: *Tapirus*, No. 53, Frič, "levá" (= left). N: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93472; a mixture of separated poorly preserved tapir left limb bones: humerus, fibula, tibia, incomplete posterior autopodium (three metatarsal sesamoid bones). **O**: *Tapirus*, No. 56, Frič, 1905, "levá, pravá, bez jablka" (= left and right [limb bones] without kneecap). **N**: *Tapirus* sp., we are not able to provide exact species identification. Incompletely fused epiphyses indicate an immature individual.

NMP 93473; well preserved complete right anterior autopodium. **O**: *Tapirus*, No. 65, Frič, "tarsus, přední pravý" (= right anterior 'tarsus'). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93474; well preserved complete right anterior autopodium. **O**: *Tapirus*, No. 66, Frič, "tarsus, přední pravý" (= right anterior 'tarsus'). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93475; well preserved complete right anterior autopodium. **O**: *Tapirus*, No. 67, Frič. **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93476; well preserved complete left anterior autopodium. **O**: *Tapirus*, No. 70, Frič, "tarsus, přední levý" (= left anterior 'tarsus'). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93477; well preserved complete right anterior autopodium. **O**: *Tapirus*, No. 71, Frič. **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93478; well preserved complete left anterior autopodium. **O**: *Tapirus*, No. 73, Frič, "tarsus, přední levý" (= left anterior 'tarsus'). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93479; poorly preserved complete left anterior autopodium and antebrachium. Only distal parts (thirds) of ulna and radius are preserved. **O**: *Tapirus*, No. 74, Frič, "tarsus, přední levý" (= left anterior 'tarsus'). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93480; well preserved incomplete skeleton of the right anterior autopodium and antebrachium. **O**: *Tapirus* sp., No. 75, V. Frič, "přední pravá k lokti" (= right fore[limb from foot] to the elbow). **N**: *Tapirus* sp., we are not able to provide exact species identification. Incompletely fused epiphyses indicate an immature individual.

NMP 93481; well preserved complete left anterior autopodium (mounted by iron wires) and dissociated antebrachium. **O**: *Tapirus*, No. 77, Frič, "přední pravá k lokti" (= right fore[limb from foot] to the elbow). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93482; poorly preserved bones of the right forelimb without humerus and distal phalangi, all parts mounted by iron wires. **O**: *Tapirus* sp., No. 78, V. Frič, "přední pravá k lokti" (= right fore[limb from foot] to the elbow). **N**: *Tapirus* sp., we are not able to provide exact species identification. Unfused epiphyses indicate an immature individual.

NMP 93483; well preserved complete left anterior autopodium and dissociated antebrachium. **O**: *Tapirus*, No. 80, Frič, "přední levá k lokti" (= left fore[limb from foot] to the elbow). **N**: *Tapirus* sp., we are not able to provide exact species identification. Incompletely fused epiphyses indicate an immature individual.

NMP 93484; well preserved complete left anterior autopodium and antebrachium. **O**: *Tapirus*, No. 81, Frič. **N**: *Tapirus* sp., we are not able to provide exact species identification. Incompletely fused epiphyses indicate an immature individual.

NMP 93485; well preserved left ulna associated with fused radius. **O**: *Tapirus* sp., No. 82, V. Frič, "levá" (= left [limb]). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93486; well preserved left ulna and radius and several isolated carpal and metacarpal bones. **O**: *Tapirus*, No. 83, Frič. **N**: *Tapirus* sp., we are not able to provide exact species identification. Incompletely fused epiphyses indicate an immature individual.

NMP 93487; well preserved complete right posterior autopodium and antebrachium. **O**: *Tapirus*, No. 84, Frič, "zadní pravá ke koleni" (= right hind[limb from foot] to the knee). **N**: *Tapirus* sp., we are not able to provide exact species identification. Incompletely fused epiphyses indicate an immature individual.

NMP 93488; well preserved complete right posterior autopodium (mounted by iron wires) and crus. **O**: *Tapirus*, No. 85, Frič, "zadní pravá ke koleni" (= right hind[limb from foot] to the knee). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93489; well preserved complete right posterior autopodium and crus. **O**: *Tapirus*, No. 86, Frič, "zadní pravá ke koleni" (= right hind[limb from foot] to the knee). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93490; well preserved left tibia associated with fibula (mounted by iron wires). **O**: *Tapirus* sp., No. 87, "zadní pravá ke koleni" (= right hind[limb from foot] to the knee). **N**: *Tapirus* sp., we are not able to provide exact species identification. Incompletely fused epiphyses indicate an immature individual.

NMP 93491; well preserved complete right posterior autopodium and dissociated crus. **O**: *Tapirus*, No. 88, Frič. **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93492; well preserved right crus. **O**: *Tapirus* sp., No. 89, "zadní pravá ke koleni" (= right hind[limb from foot] to the knee). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely unfused epiphyses indicate an immature individual.

NMP 93493; mixture of well preserved tapir limb bones, probably originating from two or more individuals. **O**: *Tapirus* sp., No. 90, V. Frič, "zadní levá ke koleni" (= left hind[limb from foot] to the knee). **N**: *Tapirus* sp., we are not able to provide exact species identification. Some bones belong to an immature individual (unfused condition of epiphyses).

NMP 93494; well preserved complete left posterior autopodium (mounted by iron wires) and crus (mounted by iron wires). **O**: *Tapirus* sp., No. 91, V. Frič, "zadní levá ke koleni" (= left hind[limb from foot] to the knee), ZK. **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93495; well preserved complete left posterior autopodium (mounted by iron wires) and dissociated crus. **O**: *Tapirus*, No. 92, Frič, "zadní levá ke koleni" (= left hind[limb from foot] to the knee). **N**: *Tapirus* sp., we are not able to provide exact species identification. Incompletely fused epiphyses indicate an immature individual.

NMP 93496; well preserved complete left posterior autopodium and dissociated crus. **O**: *Tapirus*, No. 94, Frič, "zadní levá ke koleni" (= left hind[limb from foot] to the knee). **N**: *Tapirus* sp., we are not able to provide exact species identification. Almost completely fused epiphyses indicate a mature individual.

NMP 93497; well preserved complete right posterior autopodium. **O**: *Tapirus*, No. 95, Frič. **N**: *Tapirus* sp., we are not able to provide exact species identification. Almost completely fused epiphyses indicate a mature individual.

NMP 93498; well preserved complete left posterior autopodium and crus. **O**: *Tapirus terrestris*, No. 99, Frič, "tarsus zadní levý" (= left posterior 'tarsus'). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93499; a mixture of several well preserved (anterior?) autopodial skeletons, from two or more individuals, some carpal bones are mounted together by iron wires. **O**: *Tapirus* sp., No. 10/64, "kosti končetin" (= extremity bones). **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93500; well preserved separated fragments of right forelimb: right ulna with radius, sesamoid bones, complete right autopodium. **O**: *Tapirus* sp., UP-0147, No. 69 on bones, Pfleger. **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93501; well preserved, almost complete skeleton of the left posterior autopodium without astragalus and calcaneus, mounted by iron wires. **O**: *Tapirus* sp., without number, V. Frič. **N**: *Tapirus* sp., we are not able to provide exact species identification.

NMP 93502; well preserved complete skeleton of the left posterior autopodium, mounted by iron wires. **O**: *Tapirus* sp., without number, V. Frič. **N**: *Tapirus* sp., we are not able to provide explicit species identification.

NMP 93503; well preserved three third phalanges. **O**: *Tapirus*, without number, "kopyta" (= hooves). **N**: *Tapirus* sp., we are not able to provide exact species identification.

NMP 93504; well preserved 25 isolated incisors and canines, 9 isolated molariform teeth. **O**: absent. **N**: *Tapirus* sp., we are not able to provide exact species identification. All teeth are probably associated with the specimens NMP 93442–93459, but the specific associations of teeth with skulls are unknown.

NMP 93505; well preserved left antebrachium, dissociated crus, and a left posterior autopodium. **O**: Tapir, "zadní levá" (= hind left [limb]). **N**: *Tapirus* sp., we are not able to provide exact species identification. Incompletely fused epiphyses indicate an immature individual.

NMP 93506; well preserved right humerus and ulna with radius. **O**: absent. **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

NMP 93507; well preserved right femur. **O**: absent. **N**: *Tapirus* sp., we are not able to provide exact species identification. Incompletely fused epiphyses indicate an immature individual.

NMP 93508; well preserved phalangi and metatarsal bones from the left posterior limb. **O**: absent. **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual.

IAMF D16/33; well preserved bones of the right posterior autopodium with hooves and isolated skin from the ventral part of the autopodium; one right anterior autopodium as a dermoplastic showpiece. **O**: D16/33. **N**: *Tapirus* sp., we are not able to provide exact species identification. Completely fused epiphyses indicate a mature individual. Tapir limbs (D16/33) photographed by Seichert et al. (2006: pl. 52).

R h i n o c e r o t i d a e

Ceratotherium simum (Burchell, 1817)

NMP 21896; well preserved skull with mandible, occipital condyls cut out, and both premaxillae absent. Upper dentition: four molariforms fully erupted; both P^1 absent; both M^2 erupted, but not in occlusion; both M^3 not in evidence. Lower dentition: four molariforms fully erupted; M_2 erupted, but not in occlusion; both M_3 not in evidence. **O**: *Ceratotherium simum*, ♀, Umfolozi Reserve (South Africa), captured on 10 March 1972, held in the Dvůr Králové Zoo; a.n. 20/72. **N**: *Ceratotherium simum*. Cranial sutures open. Age estimation based on teeth eruption and wear (Groves 1967b): stage 3; (Hillman-Smith et al. 1986b): VII (3.5–4 years). "Healed abscess" on the labial side (D) of mandible: 60 mm long, 36 mm high. The specimen probably originates from the female named Dinah (Studbook No. 208) captured in the Umfolozi Reserve, South Africa on 31 May 1972, died on 30 October 1974 (Ostrava Zoo, 4 years) based on the zoo evidence and age estimation (Holečková 2009: 206).

NMP 93509; poorly preserved skull with mandible, both premaxillae broken, left auditory bulla broken, occipital condyls are abraded on their ventral side. Upper dentition: four molariforms fully erupted; both M^2 erupted, but not in occlusion; both M^3 not in evidence. Lower dentition: four molariforms fully erupted; both M_2 erupting, but not in occlusion; both M_3 partly in evidence, but not erupted. **O**: ♀, Umfolozi Reserve, captured and died on 11 September 1970; No. 57 on the skull, 01/30/5. **N**: *Ceratotherium simum*. Cranial sutures open. Age estimation based on teeth eruption and wear (Groves 1967b): stage 3; (Hillman-Smith et al. 1986b): VII[–VIII] (3.5–4[–7] years). Traction epiphyses of the lachrymal tubercle (cf. Cave 1965) are well detectable. The specimen probably originates from unnamed female (Studbook No. 1158) captured in the Umfolozi Reserve, South Africa on 7 September 1970 (van den Bring, Soest), died on 28 September 1970 (Dvůr Králové Zoo, 3 years, pneumonia) based on the zoo evidence and age estimation (Holečková 2009: 206).

ZMP, unnumbered; well preserved skull with premaxillae, mandible and two horns. Upper dentition: six molariforms fully erupted; both M^3 with advanced wear; P^3 (D) compressed anterior-posteriorly and somewhat shifted labially; a gap between M^2 and M^3 (D) is present. Lower dentition: six molariforms fully erupted; both M_3 with an advanced wear. M_1 (D) is absent; both P_2, both P_3, and M_1 (S) are rudimentary or extremely worn in form of circular knobs. Two isolated, relatively slender pale brown horns. Boundary between horn base and stem is relatively well detectable in both horns, but several sharp horizontal or transversal lines are present on the anterior and right lateral side of both horns. **O**: *Ceratotherium simum*, ♀ Saša, from the Ústí nad Labem Zoo. **N**: *Ceratotherium simum*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (Hillman-Smith et al. 1986b): XIV (25–32 years). However, the female was actually 41 years old according to the zoo evidence (for discussion see below). Data on the individual from the Ústí nad Labem Zoo (P. Král, in litt.) and Holečková (2009): ♀ named Saša, wild born in 1967 (Umfolozi Reserve, South Africa), captured on 23 June 1970, transferred

to the Dvůr Králové Zoo, then to the Ústí nad Labem Zoo (19 November 1980), died on 21 March 2008 (Ústí nad Labem Zoo), Studbook No. 114 (ARKS 117008).

ZMP, unnumbered; well preserved skull with premaxillae, mandible and two horns. Upper dentition: six molariforms fully erupted; both M^3 with advanced wear; M^1 (D) extremely compressed anterior-posteriorly. Lower dentition: six molariforms fully erupted; both M_3 with an advanced wear. M_1 (S) and P_2 (D) are absent; P_2 is rudimentary, P_3 (S) extremely worn in form of two circular knobs. Two isolated, robust pale brown horns. Boundary between horn base and stem is hardly detectable in both horns, several sharp horizontal or transversal lines are present on the lateral side of the second horn. **O**: *Ceratotherium simum*, ♂ Dan, from the Ústí nad Labem Zoo. **N**: *Ceratotherium simum*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (Hillman-Smith et al. 1986b): XIV (25–32 years). However, the male was actually 38 years old according to the zoo evidence (for discussion see below). Data on the individual from the Ústí nad Labem Zoo (P. Král, in litt.) and Holečková (2009): ♂ named Dan, wild born in 1970 (Umfolozi Reserve, South Africa), captured on 15 October 1970, transferred to the Dvůr Králové Zoo, then to the Ústí nad Labem Zoo (4 December 1980), died on 28 March 2008 (Ústí nad Labem Zoo), Studbook No. 111 (ARKS 117005); nasal bosses well developed.

ZMP, unnumbered; well preserved skull with premaxillae and mandible, but the braincase and occipital condyls are cut out and not preserved. Upper dentition: six molariforms fully erupted; both M^3 with advanced wear; both P^2 absent. Lower dentition: six molariforms fully erupted; both M_3 with advanced wear; both M_2–M_3 shifted somewhat lingually. **O**: *Ceratotherium simum*, from Africa, unknown origin. **N**: *Ceratotherium simum*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (Hillman-Smith et al. 1986b): VIII[–XIV] (20–28[–32] years). One relatively thin and short process is present on the anterior side of the left condylar mandibular process.

ZMP, unnumbered; well preserved skull with premaxillae and mandible. Upper dentition: five molariforms fully erupted; both M^3 erupted, but not in occlusion. Both P^2–P^4 exhibit reciprocally assymetrical wear (the right side seems to be somewhat retarded in the wear). Lower dentition: three molariforms fully erupted; both P_2 and M_2 erupted, but not in occlusion; both M_3 in evidence; two alveoli for P_1 well detectable. **O**: *Ceratotherium simum*, from Africa, unknown origin. **N**: *Ceratotherium simum*. Cranial sutures open. Age estimation based on teeth eruption and wear (Groves 1967b): stage 5; (Hillman-Smith et al. 1986b): [X–]XI (8–15 years).

Zoo-Ostrava; well preserved skull with premaxillae, mandible and complete limb skeleton (hyoid bones, pelvis and axial skeleton not preserved). Left forelimb and hind limb are mounted on wood bases, the right ones are disarticulated. Upper dentition: all molariforms fully erupted; both M^3 with an advanced wear; both P^1 not preserved; both P^4 shifted labially. Lower dentition: six molariforms fully erupted; both M_3 with an advanced (moderate) wear; M_1 (S), P_2 (D), $M_{1–2}$ (D) are not present *in situ* and also not preserved. **O**: *Ceratotherium simum*. ♀ Dinah. **N**: *Ceratotherium simum*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (Hillman-Smith et al. 1986b): XIII (20–28 years). However, the female was actually 38 years old according to the zoo evidence (for discussion see below). Data on the individual (Holečková 2009): ♀ named Dinah, 38 years, wild born in 1970 (Umfolozi Reserve, South Africa), captured on 31 May 1972, first kept in the Dvůr Králové Zoo, since 30 October 1974 in the Ostrava Zoo, died on 7 March 2008 (Ostrava Zoo), Studbook No. 208 (ARKS 117010). Some bones seem to be partially deformed due to arthrosis.

Ceratotherium cottoni (Lydekker, 1908)

NMP 47145; well preserved, almost complete disarticulated skeleton with corneous hooves, skull with premaxillae and mandible, and two horns; many vertebrae mising (39 vertebrae observed, comp. the expected 54–57 vertebrae; Groves 1972). Upper and lower dentitions: six molariforms fully erupted (Fig. 5); both M^3 and M_3 with only a little wear; P^4 (D) shifted lingually; both P_3 remarkably smaller than other molariforms; M_1 (S) shifted labially. Two isolated, robust, pale brown and similarly-sized horns; boundary

between horn base and stem hardly detectable in both horns. The first horn with several sharp horizontal lines on the anterior and posterior sides; several hairs detectable on the horn base (6–10 mm long). **O**: *Ceratotherium simum*, ♀, wild born in Uganda, died on 26 August 1992, kept in the Dvůr Králové Zoo; a.n. 31/92, original number Cer. 15/92, C2-315-R02; 0031/1992. **N**: *Ceratotherium cottoni*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (Hillman-Smith et al. 1986b): [XI–]XII ([10–]14–20 years). However, the female was actually 27 years old according to the zoo evidence (for discussion see below). Data on the individual from the Dvůr Králové Zoo: ♀ named Nasima, wild born in Uganda in 1965, died on 26 August 1992 (Dvůr Králové Zoo, collapse), Studbook No. 351.

NMP 93510; well preserved, almost complete disarticulated skeleton, skull with premaxillae and mandible; many vertebrae missing (44 vertebrae observed, comp. the expected 54–57 vertebrae; Groves 1972). Upper and lower dentitions: seven upper molariforms including both P^1 and six lower molariforms fully erupted (Fig. 6); both M^3 and M_3 with intermediate wear. Both M^1 anterior-posteriorly compressed and shifted lingually; P_3, M_1, M_2 (D) somewhat shifted lingually. **O**: ♂ of the white rhinoceros "Ben", 40 years, wild born in Africa in 1950, transferred from the London Zoo to the Dvůr Králové Zoo on 19 August 1986, died 25 June 1990 (Dvůr Králové Zoo, euthanasia), skeleton, number of veterinary protocol 111/90, evidence number 1/188. **N**: *Ceratotherium cottoni*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (Hillman-Smith et al. 1986b): XII (14–20 years). However, the male was actually 40 years old according to the zoo evidence (for discussion see below). Additional information on the individual from the Dvůr Králové Zoo: wild born in Uganda, held in the London Zoo since 25 July 1955, kept in the Dvůr Králové Zoo since 27 August 1986, Studbook No. 19. Indication of traction epiphyses of the lachrymal tubercle (cf. Cave 1965) is present; nasal bosses well developed.

NMP 93511; well preserved, almost complete skeleton, skull with premaxillae and mandible, and two horns; several vertebrae missing (52 vertebrae observed, comp. with the expected 54–57 vertebrae; Groves 1972). Upper and lower dentitions: five molariforms fully erupted (Fig. 7); both M^2 and M_2 show no or only little wear; both M^3 and M_3 partly in evidence. Two isolated robust horns; pale brown (first horn) or grey (second horn). Boundary between horn base and stem hardly detectable in both horns; the first horn possesses two shallow concavities on the anterior side – one near the horn base, another in the middle portion of the horn, the second horn possesses one shallow concavity on the anterior side near apex; the first horn is pointed slightly forward. **O**: ♀, 9 years, wild born in Sudan in 1973, captured on 13 October 1975, died on 4 January 1982; No. 570 on the mandible. **N**: *Ceratotherium cottoni*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 4; (Hillman-Smith et al. 1986b): IX (7–9 years). However, the female was actually 9 years old according to the zoo evidence (for discussion see below). Additional information on the individual from the Dvůr Králové Zoo: ♀ named Nuri, kept in the Dvůr Králové Zoo since 19 September 1975, died on 4 January 1982 (Dvůr Králové Zoo, trauma), Studbook No. 375. Traction epiphyses of the lachrymal tubercle (cf. Cave 1965) are well detectable. Hillman-Smith (1986) identified a wear class X (8–11 years) in this specimen.

NMP 93512; well preserved complete disarticulated skeleton with corneous hooves and all vertebrae (56), skull with premaxillae and mandible, and two horns. All teeth preserved, but only 7 upper and 4 lower teeth present *in situ*. Upper and lower dentitions: all molariforms fully erupted; both M^3 and M_3 with an advanced wear (Fig. 8). Only P^4–M^3 (S), P^2 (D), M^2–M^3 (D), both P_2 and M_3 are present *in situ*, but the remaining isolated teeth are preserved. Two isolated, robust pale brown to pinkish horns. Boundary between horn base and stem not well detectable in both horns. **O**: ♂, white rhinoceros, Dvůr Králové Zoo, 2007. **N**: *Ceratotherium cottoni*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (Hillman-Smith et al. 1986b): XII (14–20 years). However, the male was actually 34 years old according to the zoo evidence (for discussion see below). Information on the individual from the Dvůr Králové Zoo: ♂ named Saut, 34 years, wild born in the Shambe Reserve, Sudan, in 1972, captured in 1975, since 19 September 1975 in the Dvůr Králové Zoo, from 1989 to 1998 in the San Diego Wild Animal Park, died on 14 August 2006 (Dvůr Králové Zoo, heart collapse), Studbook No. 373.

Ceratotherium simum × *C. cottoni* crossbred

ZMP, unnumbered; well preserved complete disarticulated skeleton with corneous hooves [skull of the respective individual with premaxillae and mandible in a private collection, examined], 53 observed vertebrae, some last caudal vertebrae (1–2) seem to be absent (compared with the expected 54–57 vertebrae; cf. Groves 1972); well prepared mounted head skin with horns. (The dermoplastic specimen is very realistic; slightly forward orientation of both horns and many hairs of several types are well preserved.) Upper and lower dentition: six molariforms fully erupted; both M^3 and M_3 with only a little wear. Two relatively slender dark brown horns associated with a mounted head. Boundary between horn base and stem is not well detectable in both horns. **O**: Nasi, a crossbred ♀ of *Ceratotherium s. simum* and *C. s. cottoni*, from the Dvůr Králové Zoo. **N**: *Ceratotherium simum* × *C. cottoni* crossbred. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (Hillman-Smith et al. 1986b): XII (14–20 years). However, the female was actually 30 years old according to the zoo evidence (for discussion see below). Additional data on the individual (Holečková 2009): ♀ named Nasi, captive born on 11 November 1977 (Dvůr Králové Zoo), died on 20 June 2007 (Dvůr Králové Zoo, euthanasia, uterus cancer), Studbook No. 476 (ARKS 059008). The only known hybrid individual of the *Ceratotherium* species in the world, the crossbred status is well observable as a mosaic of morphological characters diagnostic for *C. simum* and *C. cottoni*.

Ceratotherium Gray, 1868 sp.

NMP 93513; well preserved isolated relatively slender horn, probably the first one, mounted on a wooden base; brown. **O**: absent. **N**: *Ceratotherium* sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base shows to *Ceratotherium.*

cf. *Ceratotherium* Gray, 1868 sp.

NMP 93514; well preserved isolated robust horn, probably the first one; apex slightly damaged; pale brown. Boundary between horn base and stem hardly detectable. Its morphology is markedly changed due to abrasion typical for captive rhinoceroses. **O**: absent. **N**: cf. *Ceratotherium* sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base shows to *Ceratotherium.* We tend to recognise this specimen as cf. *Ceratotherium* sp. based on the modified horn morphology.

Diceros bicornis (Linnaeus, 1758)

NMP 10657; poorly preserved skull with mandible, without premaxillae; some cracks are present on the right condylar process of mandible and the skull basis, one drilled opening above the *foramen magnum*, some teeth absent. Upper dentition: five molariforms fully erupted; both M^2 erupted, but not in full occlusion; both M^3 partly in evidence. Lower dentition: five molariforms fully erupted including both P_1; both M_2 erupted, but not in full occlusion; both M_3 partly in evidence. **O**: absent. **N**: *Diceros bicornis.* Cranial sutures open. Age estimation based on teeth eruption and wear (Groves 1967b): stage 3; (du Toit 1987a): less than X (6–12 years). Indication of traction epiphyses of the lachrymal tubercle (cf. Cave 1965) is present. According to old NMP museum evidence, the specimen was donated to the collection by Emil Holub in February 1894. Considering the second journey by E. Holub, the specimen should be associated with the southern African region (see also below), it could thus be identified as *D. b. chobiensis* or *D. b. minor* (Groves 1967a, Rookmaaker & Groves 1978, Hillman-Smith & Groves 1994). The southern African origin of this specimen seems to be confirmed due to the combination of presence of the bifid infraorbital foramen (present dextrally) and the first mandibular premolars (bilaterally) and of absence of crista (Rookmaaker & Groves 1978, Hillman-Smith & Groves 1994).

Table 2. Measurements of rhinoceros skulls (in mm) taken according to Guérin (1980), du Toit (1987a), and Groves (1967a, b, 1993b). Two values under one dimension (X/Y) are associated with left and right side, respectively. For abbreviations see Abbreviations and Table 3, pmx – premaxillae presence

Tab. 2. Lebeční rozměry revidovaných nosorožců (v mm) měřených podle Guérina (1980), du Toita (1987a), a Groves (1967a, b, 1993b). Dva číselné údaje u jednoho rozměru (X/Y) se vztahují k levé a pravé straně lebky. Zkratky rozměrů viz Abbreviations a tab. 3. pmx – mezičelist

No.	t.	pmx.	LCb	LB	LaZ	LaO	LaM	AO	LaN	PMs	CV	LaPO	LaSO	LaAO	LaI+
NMP 93515	*Db*	[+]	564	~522	339	207	233	144	134	–/246	76	183	244	253	79
NMP 21896	*Cs*	–	>547	~513	274	151	194	119	110	164/166	58	159	183	206	~19
NMP 47145	*Cc*	+	708	642	320	197	248	167	160	252/250	43	180	245	255	47
NMP 25963	*Dbm*	–	561	497	323	177	226	160	142	247/248	80	191	266	273	48
NMP 47655	*Dbm*	+	584	528	323	189	236	158	149	249/255	61	181	271	271	68
NMP 93510	*Cc*	+	716	636	335	243	255	160	209	314/314	51	201	304	322	46
NMP 93511	*Cc*	+	665	619	328	215	229	158	141	234/234	35	200	263	263	62
NMP 93509	*Cs*	–	547	502	260	141	185	123	108	162/162	55	~146	176	189	38
NMP 25964	*Dbm*	[+]	595	541	334	188	246	153	151	265/266	50	172	257	261	64
NMP 48347	*Dbm*	+	618	549	341	191	233	153	154	269/267	47	176	255	262	87
NMP 50026	*Ru*	+	285	284	175	161	137	70	72	85/85	16	96	~101	114	–
NMP 93521	*Dbm*	–	608	537	341	196	233	149	133	281/~277	64	166	250	249	64
NMP 93520	*Dbm*	–	581	503	314	176	220	152	140	258/259	62	155	229	234	63
NMP 93519	*Dbm*	–	565	498	328	190	207	155	131	277/–	64	171	237	246	65
NMP 93517	*Db*	–	602	528	330	193	243	157	148	256/249	56	174	242	247	88
NMP 10657	*Db*	–	536	483	309	165	216	146	122	181/180	54	163	212	216	–
NMP 93516	*Db*	[+]	657	566	368	233	270	~182	162	262/268	58	188	281	275	117
NMP 93512	*Cc*	+	712	627	321	243	244	164	189	281/285	33	206	278	291	63
HFN 839	*Ru*	+	621	567	349	200	~302	168	95	~264/~267	67	190	204	174	57
ZMP Sasa	*Cs*	+	731/730	672	351	239	259	181	186	301/~312	63	228	290	306	52
ZMP Dan	*Cs*	+	772	671	359	267	315	186	202	273/278	75	214	324	341	47
ZMP unn.	*Cs*	+	715	648	337	198	228	166	190	215/–	74	283	257	217	60
ZMP unn.	*Cs*	+	>700	>670	336	–	–	–	175	250/251	–	226	308	309	94
ZMP unn.	*s×c*	+	745/740	698	360	260	285	200	183	293/286	75	215	293	293	69
ZMP Jiddah	*Dbm*	+	568	518	318	192	234	154	132	273/271	–	170	241	~243	72
ZMP Jimmi	*Dbm*	+	565/563	530	319	190	213	155	132	271/269	74	170	241	243	75
ZMP Diceros 01	*Db*	–	~431	~401	248	132	170	103	92	183/181	–	125	162	162	~60
Zoo-Dvur Sali	*Dbm*	–	607/606	545	351	181	247	161	146	267/267	68	187	260	262	88
Zoo-Dvur 105892	*Dbm*	+	617	562	334	194	235	162	148	–/276	69	186	262	263	71
Zoo-Ostrava	*Cs*	+	665/664	629	336	229	248	167	167	259/264	72	201	315	321	58

Table 2. (continued)
Tab. 2. (pokračování)

No.	LaI	PC	LDm	LD	PO	AF	M2LaCO		ACr	ACn	LMd	LSM	PMi
NMP 93515	109	26	515	526	5	~195/~194	54/52	125	247/250	199/203	459/453	104	212/213
NMP 21896	91	–	515	546	31	~187/~179	–	–	228/229	159/164	439	85	156/156
NMP 47145	99	30	666	723	52	~242/~242	71/72	134	260/282	186/205	517/510	90	244/252
NMP 25963	113	23	517	531	16	~203/~202	42/45	128	240/246	191/198	458/457	103	233/222
NMP 47655	117	24	529	555	24	~207/~206	28/36	130	235/233	186/190	440/433	100	247/245
NMP 93510	109	23	733	793	55	~257/~247	~59/~56	149	323/318	232/224	498/512	116	269/263
NMP 93511	110	28	678	721	41	~238/~234	~47/~47	143	283/281	208/199	492/490	80	227/223
NMP 93509	93	24	515	531	17	~182/~172	–	145	210/207	157/155	414/414	~73	147/147
NMP 25964	114	22	580	589	4	~207/~210	54/54	229	222/217	178/179	455/453	108	246/248
NMP 48347	123	25	640	645	–	~230/~230	50/50	144	216/221	164/164	453/458	111	249/~255
NMP 50026	91	21	250	257/261	8	~100/~100	–	88	124/129	~110/119	257/261	~32	–/–
NMP 93521	126	25	576	582	3	~204/~208	54/52	135	226/223	177/178	453/442	109	275/267
NMP 93520	114	25	567	580	4	~193/~193	56/52	139	213/212	166/167	442/442	101	258/–
NMP 93519	110	24	502	521	17	~198/~202	52/56	122	241/241	–	434/436	98	269/–
NMP 93517	120	25	538	560	15	~198/~200	54/54	131	224/227	–	447/445	98	265/264
NMP 10657	109	24	502	520/516	15	~177/~169	49/51	132	237/232	201/195	417/418	95	–/222
NMP 93516	~137	28	~607	~623	7	~231/~223	61/71	136	261/265	218/227	481/479	112	302/291
NMP 93512	114	25	700	758	56	~257/~255	~58/~59	133	303/300	220/218	502/493	122	~268/~273
HFN 839	115	30	516	523/541	8	~160/~160	53/50	135	–	–	509/508	–	~270/272
ZMP Sasa	113	30	750	782	25	~233/~234	63/78	154	299/307	~229/~241	551/549	100	~254/~262
ZMP Dan	115	~27	827	867	31	~257/~265	59/66	166	275/317	241	546/546	96	236/257
ZMP unn.	111	34	694	712/718	23	~227/~232	58/57	158	285/296	204/209	527/531	80	146/142
ZMP unn.	108	–	–	–	–	~224/~218	42/39	–	309/306	227/226	574	108	~268/~272
ZMP unn.	113	29	703	749/746	42	~222/~221	71/70	165	~311/~305	222/226	556/545	85	301/301
ZMP Jiddah	112	29	522	536	12	~170/~175	53/55	131	230/228	193/191	442/438	105	269/269
ZMP Jimmi	112	29	527	546/541	11	~192/~197	55/57	131	224/233	196/205	440/427	97	258/257
ZMP Diceros 01	99	~21	392	390	–	~134/~133	–/–	124	181/180	143/137	356/355	67	119/119
Zoo-Dvur Sali	55	31	553	568/572	17	~226/~223	~42/~54	147	228/230	170/170	459/457	93	257/–
Zoo-Dvur 105892	127	23	597	600	5	~186/~192	50/49	137	224/223	174/174	422/439	96	273/–
Zoo-Ostrava	105	31	668	–/707	31	~231/~224	85/90	159	304/304	224/242	536/531	106	269/~263

NMP 10706; mounted head on a wooden table (currently placed in the permanent NMP exhibition). **O**: 1894, leg. Dr. Emil Holub; 3588/1894. **N**: *Diceros bicornis*. Considering the second journey by E. Holub, the specimen should be associated with Southern Africa (see also below), so it could be identified as *D. b. chobiensis* or *D. b. minor* (Groves 1967a, Rookmaaker & Groves 1978, Hillman-Smith & Groves 1994). The specimen was originally present as a complete mounted specimen in the permanent NMP exhibition (see e.g. Štěpánek 1975: 130), since 1987, only the head with horns and a tail (P6d-2005/0045) remain in the collection, the rest of the specimen was damaged.

NMP 57438; two well preserved, associated, relatively slender horns with bordered skin sections and wooden base; brown. Partly (naturally) broken apex on the posterior side of the second horn, one small horn projection (50 mm high, 20 mm long, 34 mm wide) from the anterior side of the second horn base. **O**: *Ceratotherium simum*, Kenya, 1935; C2-115-A03, 0102/2004, unknown origin. **N**: *Diceros bicornis*. Based on the characters given by Groves (1971) the horns certainly belong to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*. The original identification of the specimen is not congruent with its original origin (see the original distribution of *Ceratotherium* described by Schomber 1966). This specific horn pair is associated with Adolf Schwarzenberg and his safari trip in 1934–1935 across Kenya and Tanganyika as described by Slabová & Slaba (2010). Considering all evidence available (date, geographic origin, identification of the specimen, relative inaccessibility of *Ceratotherium cottoni* due to a limited number of hunting permissions [cf. Machulka 1958] and mainly the evidence provided by Slabová & Slaba 2010), we tend to identify the specimen as *Diceros bicornis* from Kenya (*D. b. ladoensis*, *D. b. michaeli* or *D. b. minor*; cf. Groves 1967a, Hillman-Smith & Groves 1994). [This horn pair was recently (20 November 2010) stolen from the temporary exhibition "African expeditions of Adolf Schwarzenberg" in the National Museum of Agriculture, Letná (Prague)].

NMP 57825; two well preserved, associated, relatively slender horns bordered by skin sections on the nasal portion of skull; dark brown to black. Many hairs detectable on the skin sections. **O**: *Diceros bicornis*, Simba, Africa, coll. Pálfy; Březnice 030, the rest of the mounted rhinoceros head, damaged in the Chřibská depository, C2-315-R01, 7028/1953, 0110/2005, from the Pálfy state possession, Březnice. **N**: *Diceros bicornis*. Based on the characters given by Groves (1971) the horns certainly belong to Dicerotinae; the anteroposterior diameter of the first horn base does not discriminate between *Ceratotherium* and *Diceros*, but the second horn indicates the *Ceratotherium* diagnosis. We can definitely support the original identification on an old photo published by Štěpánek (1975), in which a mounted head of *Diceros bicornis* with this specific horn pair and the wooden base with the "Simba" writing is present. If the geographical term "Simba" corresponds with Simba in southern Kenya (Groves 1967a) or the Simba Hills on the present border between Kenya and Tanzania, the specimen could be tentatively identified as *Diceros bicornis michaeli* (Groves 1967a, Hillman-Smith & Groves 1994); anyway, all other rhinoceros horns from the Pálfy's collection are geographically associated with Kenya (see other specimens in this catalogue), thus, all Pálfy's specimens should belong to *D. bicornis ladoensis*, *D. b. michaeli* or *D. b. minor* (Groves 1967a, Hillman-Smith & Groves 1994).

NMP 57829; two well preserved, isolated, relatively slender horns; dark brown to black. **O**: *Diceros bicornis*; C2-315-R01, 0006/2006, origin unknown, old collection, data lost. **N**: *Diceros bicornis*. Based on the characters given by Groves (1971) the horns certainly belong to Dicerotinae; the anteroposterior diameter of horn base shows to *Diceros*, concordantly with the original labelling of the specimen.

NMP 57831; two well preserved horns with a wooden base; chestnut brown. **O**: Rhinocerotidae sp., Serengeti, Tanganyika, 17 December 1934, coll. Hanau-Schaumburk; C-115-03a, 7016/1953, from state possession – NKK 3441/1948. **N**: *Diceros bicornis*. Based on the characters given by Groves (1971) the horns certainly belong to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale known in *Diceros*. According to the geographic origin, the specimen could be specified as *D. b. minor* or *D. b. michaeli*, bet certainly not as *Ceratotherium* sp. (see Groves 1967a, 1972, Princ 1990, Hillman-Smith & Groves 1994).

NMP 57835; well preserved, isolated, relatively slender horn, probably the first one; dark brown. **O**: *Diceros bicornis*; C2-315-R01, 0006/2006, origin unknown, old collection, evidence lost. **N**: *Diceros bicornis*. Based on the characters given by Groves (1971) the horns certainly belong to Dicerotinae; the anteroposterior diameter of horn base shows to *Diceros*, concordantly with the original labelling.

NMP 57836; well preserved, isolated, relatively robust horn, probably the first one; dark brown. **O**: *Diceros bicornis*; C2-315-R01, 0006/2006, origin unknown, old collection, evidence lost. **N**: *Diceros bicornis*. Based on the characters given by Groves (1971) the horns certainly belong to Dicerotinae; the anteroposterior diameter of horn base shows to *Diceros*, concordantly with the original labelling.

NMP 93515; well preserved skull with mandible, premaxilla (S) movable, premaxilla (D) broken. Upper dentition: six molariforms fully erupted, including P^1; both M^3 erupted, not in occlusion; P^1 (S) absent. Lower dentition: five molariforms fully erupted; both M_3 erupted, not in occlusion; P_1 (S) absent, but a rudimentary P_1 (D) present. **O**: absent. **N**: *Diceros bicornis*. Cranial sutures relatively closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 5; (du Toit 1987a): X (6–12 years). Traction epiphyses of the lachrymal tubercle (Cave 1965) are well detectable.

NMP 93516; poorly preserved skull with mandible, one premaxilla absent, both coronoid processes of mandible somewhat abraded, the dorsal portion of braincase is cut out, but preserved. Upper dentition: six molariforms fully erupted, including P^1; both M^3 erupted, but not in occlusion. Lower dentition: six molariforms fully erupted; both M_3 nearly in occlusion; P_1 (S) preserved, but P_1 (D) absent. **O**: absent. **N**: *Diceros bicornis*. Cranial sutures relatively closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 5; (du Toit 1987a): X (6–12 years). Indication of traction epiphyses of the lachrymal tubercle (Cave 1965) is present.

NMP 93517; well preserved skull with mandible, both premaxillae absent. Deep groove in the interorbital region. Upper and lower dentition: all molariforms fully erupted including both P^1 and P_1; both M^3 and M_3 with no wear. **O**: No. 310 on the skull. **N**: *Diceros bicornis*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (du Toit 1987a): XI (7–13 years).

HFM 415 (415/70); two associated, well preserved, relatively slender horns with bordered skin sections and a wooden base; chestnut brown to black; several hairs detectable on the preserved skin (up to 10 mm in length). **O**: Ulukenia (Kenya), 4 March 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: Accepting the geographic origin labelled (Ulu, Kenya, 01° 49' S, 37° 09' E), the specimen could be identified as *D. b. michaeli* (Groves 1967a).

HFM 418 (418/70); three well preserved pairs of associated horns with bordered skin sections and wooden bases; dark brown to black. Two longer pairs of horns are slender, one smaller pair (of a juvenile individual) is relatively robust; several isolated hairs detectable on the preserved skin. **O**: Salt River (Kenya), 30 January 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: we did not identify the precise position of the Salt River, the specimen could thus belong to *D. bicornis ladoensis*, *D. b. michaeli* or *D. b. minor* (Groves 1967a, Hillman-Smith & Groves 1994).

HFM 820 (39/63); well preserved, isolated, relatively slender horn, with a wooden base; black. **O**: East Africa, 1896; *Ceratotherium simum* (revised by Hanák et al. 2003). **N**: if the species identification and geographic origin given by Hanák et al. (2003) is accepted, the specimen belongs to *Ceratotherium cottoni* and the mentioned year would precede discovery of this species by major Gibbons (Machulka 1958, Heller 1913). Based on the characters given by Groves (1971) the horns certainly belong to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale of *Diceros*. This specimen probably belongs to *Diceros bicornis* from Kenya, because all specimens shot by H. Lichtenstein in 1896 have an origin in the present-day Kenya. The specimen could belong to *D. bicornis ladoensis*, *D. b. michaeli* or *D. b. minor* (Groves 1967a, Hillman-Smith & Groves 1994).

Table 3. Measurements of rhinoceros horns (in mm) taken according to Groves (1971). For dimension acronyms see Abbreviations, p. 240; ~ – approximated value

Tab. 3. Rozměry nosorožčích rohů (v mm) měřené podle Grovese (1971). Zkratky rozměrů viz Abbreviations, str. 240; ~ – přibližná hodnota

Other abbreviations / ostatní zkratky: p. – position / pořadí; t. – taxon; RHI – Rhinocerotidae sp.; Dic – Dicerotinae sp.; *Cc – Ceratotherium cottoni*, *Cs – Ceratotherium simum*, *s×c – Ceratotherium simum* and *C. cottoni* crossbred, *C*sp – *Ceratotherium* sp., *Db – Diceros bicornis*, *Dbm – Diceros bicornis michaeli*, *Dbr – Diceros bicornis minor*, *Ds – Dicerorhinus sumatrensis*, *Ru – Rhinoceros unicornis*, Rhin – Rhinocerotinae sp.

No.	p.	t.	DBA	DBT	DCA	DCT	ABA	ABS	ABP	ABD	LCA	LCP	LC	LCD
NMP 37572	I.	Dic	154	165	75	77	223	166	105	158	1095	1035	1034	1013
NMP 47145	I.	*Cc*	185	159	~138	112	~175	~201	~182	~169	435	405	424	–
	II.		145	142	127	72	43	65	62	72	385	340	385	–
NMP 47655	I.	*Dbm*	134	139	~71	~64	~200	~206	~202	~194	395	345	343	335
	II.		149	132	~103	50	~133	~126	~131	~156	220	190	222	–
NMP 48347	I.	*Dbm*	134	136	123	~86	~26	~26	~38	~26	180	160	167	–
	II.		133	114	104	~79	~22	~22	~78	~22	200	130	153	–
NMP 49731	I.	*Ds*	90	88	63	62	55	46	68	52	190	175	188	–
NMP 54481	I.	Dic	165	134	92	78	~165	~120	~135	~160	892	830	812	728
NMP 57254	I.	Dic	164	168	82	73	170	160	138	150	315	270	293	–
	II.		185	155	115	80	75	107	102	77	185	210	215	–
NMP 57261	I.	Dic	143	132	95	95	190	135	125	140	595	535	535	~493
	II.		203	145	117	82	125	85	90	90	275	285	~265	–
NMP 57399	I.	*Dbr*	153	144	83.5	66	128	134	118	126	395	345	364	–
	II.		142	137	61	47	87	102	81	96	195	175	187	–
NMP 57438	I.	*Db*	142	141	76	62	108	176	162	165	460	~390	425	~401
	II.		171	136	81	55	~145	150	120	~155	~235	225	250	–
NMP 57666	I.	Dic	159	148	91	93	163	175	118	122	645	605	605	575
NMP 57667	II.	RHI	212	150	198	140	~42	~24	~17	~17	365	370	400	–
NMP 57825	I.	*Db*	156	146	94	72	138	~135	128	129	442	375	395	–
	II.	*Db*	184	127	80	54	97	~125	120	112	220	220	225	–
NMP 57826	I?	RHI	164	163	132	139	60	68	53	~93	330	240	275	262
NMP 57827	I.	RHI	163	155	~155	~141	~40	~57	~84	~54	550	525	540	–
NMP 57828	II?	RHI	152	150	~127	~107	~47	~94	~30	~80	225	250	264	–
NMP 57829	I.	*Db*	132	137	71	65	109	88	90	106	607	580	575	545
	II.		118	117	47	44	110	116	120	109	322	310	275	–
NMP 57830	I.	Dic	112	85	~66	~46	97	81	79	84	263	220	231	221
	II.		111	93	~46	~33	80	86	79	96	110	103	123	–
NMP 57831	I.	*Db*	164	150	91	90	139	107	120	109	425	365	365	–
	II.	*Db*	148	149	78	67	85	103	78	105	195	200	222	–
NMP 57832	I.	*Dbm*	153	158	–	–	–	–	–	–	~270	150	216	201
	II.		169	152	64	55	107	110	137	136	205	230	258	256
NMP 57833	I.	*Dbm*	131	123	74	56	160	~135	183	152	458	390	~400	370
	II.		141	115	56	47	111	120	101	112	210	200	213	–
NMP 57834	I.	*Dbm*	138	128	88	65	100	103	80	116	345	295	310	284
	II.		170	170	74	66	61	93	69	90	160	160	180	–
NMP 57835	I.	*Db*	114	121	66	50	124	135	130	123	470	435	430	420
NMP 57836	I.	*Db*	115	113	74	81	75	66	104	82	343	307	305	–
NMP 57837	II.	Dic	159	149	~85	~42	~123	~154	~116	~138	233	240	252	–

No.	p.	t.	DBA	DBT	DCA	DCT	ABA	ABS	ABP	ABD	LCA	LCP	LC	LCD
NMP 57838	II.	Dic	164	129	~59	~34	~120	~137	~122	~159	155	168	181	–
NMP 57839	I.	Dic	137	124	74	52	79	128	128	124	410	355	369	341
NMP 57840	I.	Dic	133	133	66	52	195	190	202	208	390	320	337	320
NMP 57841	I.	Dic	110	92	69	57	93	83	90	88	243	195	194	–
NMP 57842	II.	Dic	135	124	~66	~51	~104	~126	~94	~120	260	255	278	–
NMP 93511	I.	*Cc*	163	136	~99	~60	~140	~100	~130	~110	260	270	280	–
	II.		147	142	~105	~52	~80	~50	~85	~55	160	130	153	–
NMP 93512	I.	*Cc*	193	179	~116	~83	~330	~190	~330	~230	705	~510	550	353
	II.		185	178	150	~75	75	~35	130	40	300	310	330	–
NMP 93513	I.	*C*sp	185	148	131	89	~88	110	95	105	865	785	783	685
NMP 93514	I.	*C*sp	182	166	165	140	~117	~133	~105	~148	325	368	348	–
NMP 93518	I.	*Db*	~119	~60	~50	~21	~165	~177	~148	–	380	320	335	304
NMP [2007]	I.	*Dbm*	175	157	128	102	145	~90	155	120	435	325	390	310
	II.		~169	129	~140	70	90	30	125	40	225	185	210	–
HFM 376	I.	*Dbm*	125	109	~45	47	150	120	180	~150	375	335	332	315
	II.		132	127	48	43	130	100	130	140	200	180	215	–
dtto	I.	*Dbm*	119	93	63	48	115	100	80	100	250	175	195	188
	II.		93	95	52	53	50	45	40	50	110	75	95	–
HFM 377	I.	*Dbm*	128	127	~74	64	135	~170	150	125	505	445	450	425
	II.		138	113	77	46	120	135	115	140	385	355	390	–
HFM 411	I.	*Dbm*	113	90	65	49	40	40	35	40	230	160	193	180
	II.		95	88	67	73	35	20	20	20	70	75	85	–
dtto	I.	*Dbm*	138	120	95	81	100	100	~90	100	353	325	322	–
	II.		155	105	113	47	80	85	80	–	182	210	215	–
HFM 412	I.	*Dbm*	138	134	55	45	~145	~150	150	~140	350	285	322	–
	II.		159	125	55	36	~115	100	80	110	205	205	230	–
HFM 413	I.	*Dbm*	150	154	70	50	140	185	140	175	440	370	410	400
	II.		149	140	~89	41	75	120	90	130	200	225	235	–
HFM 414	I.	*Dbm*	104	83	~86	~69	~30	~45	~30	~55	205	130	165	148
	II.		83	87	~55	~61	30	35	25	30	55	75	84	–
HFM 415	I.	*Db*	113	102	69	60	100	100	105	100	265	230	233	–
	II.		108	92	66	56	50	75	60	60	95	105	110	–
HFM 417	I.	*Dbm*	117	100	80	66	110	130	120	130	185	225	233	–
	II.		105	100	53	47	60	60	65	60	100	90	108	–
dtto	I.	*Dbm*	155	156	73	56	125	210	240	220	560	425	488	474
	II.		188	146	118	53	90	~150	140	~120	255	280	305	–
dtto	I.	*Dbm*	151	131	83	78	110	85	125	100	360	365	325	–
	II.		170	136	93	76	115	125	~100	95	305	350	364	–
HFM 418	I.	*Db*	75	65	51	38	30	40	40	30	110	80	95	–
	II.		54	50	23	18	20	25	20	30	30	40	35	–
dtto	I.	*Db*	165	160	~61	~36	120	170	190	170	420	330	360	–
	II.		158	153	77	38	90	110	115	120	180	180	210	–
dtto	I.	*Db*	129	125	56	48	120	120	125	120	355	305	315	–
	II.		141	131	51	55	95	90	120	95	350	330	355	–
HFM 419	I.	*Dbm*	125	110	68	47	~90	~110	120	~100	305	290	292	–
	II.		130	124	71	37	90	100	100	~100	215	205	234	–
dtto	I.	*Dbm*	137	118	99	80	110	110	70	105	390	305	325	–
	II.		139	114	94	70	50	70	55	70	140	150	157	–
dtto	I.	*Dbm*	116	107	81	66	110	110	80	110	290	225	240	–

Table 3. (continued)
Tab. 3. (pokračování)

No.	p.	t.	DBA	DBT	DCA	DCT	ABA	ABS	ABP	ABD	LCA	LCP	LC	LCD
dtto	II.		109	106	71	60	50	50	~50	50	95	100	105	–
HFM 785	I.	*Dbm*	121	104	88	74	55	55	40	55	270	185	220	185
	II.		134	97	105	74	30	40	30	30	130	155	145	–
HFM 787	I.	*Dbm*	134	120	~104	~86	~80	~100	~100	~75	460	400	395	385
	II.		139	114	78	64	~80	~100	~100	~60	230	230	230	–
HFM 789	I.	*Dbm*	120	101	104	86	95	95	100	95	315	275	280	–
	II.		114	128	107	87	60	70	20	65	160	135	160	–
HFM 820	I.	*Db*	141	123	57	56	190	215	240	215	640	630	633	–
HFM 840	I.	*Ru*	230	125	147	82	33	40	30	40	215	195	185	–
HFM 841	I.	Dic	180	180	96	98	220	210	260	180	855	830	844	814
HFM 898	I.	*Db*	131	130	71	52	145	140	150	140	390	340	356	343
	II.		125	131	51	46	150	90	115	~100	170	170	180	–
HFM unn. [64]	I.	*Db*	100	90	82	64	45	45	30	50	195	165	178	–
	II.		84	90	52.6	62	40	38	60	30	70	90	85	–
ZMP unn.	I.	Rhin	147	159	111	114	~55	~50	~40	~55	220	130	190	140
ZMP unn. Dan	I.	*Cs*	248	190	~135	~208	~125	~135	~125	~130	330	240	290	260
	II.		175	200	~140	~112	~45	–	~35	–	160	85	153	–
ZMP unn. Sasa	I.	*Cs*	205	188	139	125	200	235	170	185	494	~425	467	432
	II.		126	150	~94	~85	100	105	~145	~115	~220	~150	~235	–
ZMP unn.	I.	*s×c*	198	191	131	137	~260	~260	~270	~260	610	620	620	–
	II.		152	155	133	95	~115	~95	~100	~150	380	430	455	–

HFM 898 (117/63); two well preserved, associated, relatively slender horns, with bordered skin sections and a wooden base; dark brown. **O**: Kenya, 1936, leg. Ferdinand Andreas Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: the specimen could belong to *D. bicornis ladoensis*, *D. b. michaeli* or *D. m. minor*, based on the geographic origin (Groves 1967a, Hillman-Smith & Groves 1994).

HFM unnumbered (64); two well preserved, associated, relatively robust horns, with bordered skin sections and a wooden base; dark brown to black. **O**: East Africa (Ost-Afrika), 1896. **N**: *Diceros bicornis*. Based on the characters given by Groves (1971) the horns probably belong to Dicerotinae; the antero-posterior diameter of horn base shows to *Diceros*, but the individual is probably a juvenile. Originally, we tended to identify the specimen as cf. *Diceros bicornis* due to its probable juvenile status and thus the difficulty of its taxonomic evaluation. However, this specimen most probably belongs to *Diceros bicornis* from Kenya, because all specimens shot by H. Lichtenstein in 1896 have an origin in the present-day Kenya. The specimen could belong to *D. bicornis ladoensis*, *D. b. michaeli* or *D. b. minor* (Groves 1967a, Hillman-Smith & Groves 1994).

ZMP, unnumbered [for purposes of this catalogue tentatively numbered as ZMP *Diceros* 01]; poorly preserved skull with mandible, with both premaxillae absent and with abraded occipital condyles. Upper dentition: four molariforms fully erupted, both M^1 erupting, but not in occlusion. Lower dentition: four molariforms fully erupted, both M_1 in evidence, but not fully erupted; M_2 in a partial evidence; indices of two shallow pairs of alveoli for lower incisors. **O**: *Diceros bicornis*, unknown origin. **N**: *Diceros bicornis*. Cranial sutures relatively open. Age estimation based on teeth eruption and wear (Groves 1967b): stage 2; (du Toit 1987a): less than X (6–12 years).

cf. *Diceros bicornis* (Linnaeus, 1758)

NMP 93518; well preserved, isolated slender horn, probably the first one, cut lengthways to two halves, but only the left one is preserved; dark brown. Approx. 120 dark bands are detectable on the section. **O**: absent. **N**: cf. *Diceros bicornis*. Based on the characters given by Groves (1971) the horn certainly belongs to Dicerotinae; the anteroposterior diameter of horn base shows to *Diceros*. However, we tend to identify the horn as cf. *Diceros bicornis* due to the section and certain difficulty in determination.

Diceros bicornis michaeli Zukowsky, 1965

NMP 57832; two well preserved, associated horns bordered by skin sections on the nasal portion of skull; the first horn is smaller and more robust than the second one and the former one possesses several spherical "swellings" (Fig. 9); chestnut brown. **O**: Rhinocerotidae sp., Stoni Atthi, Africa, coll. Pálfy; Březnice 0031, the rest of the mounted rhinoceros head, damaged in the Chřibská depository, C2-315-R01, 7028/1953, from the Pálfy state possession, Březnice. **N**: *Diceros bicornis michaeli*. Based on the characters given by Groves (1971) the horn certainly belongs to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale known in *Diceros*. We can definitely identify this horn pair as *D. bicornis* based on an old photo of a mounted head of *D. bicornis* (published by Štěpánek 1975) showing the specific horn pair associated with a wooden base labelled "Athi". If Stoni Atthi corresponds with the Athi River, or Stony Athi, or the Athi Plains from Kenya (see Hanák et al. 2003), we identify this specimen with certainty as *D. b. michaeli* (Groves 1967a, Hillman-Smith & Groves 1994).

NMP 57833; two well preserved, associated, relatively slender horns with a wooden base; brown. **O**: *Diceros bicornis*, Tana river; determined by O. Štepánek; C2 -115-03a, 7028/1953, from state possession – NKK 8850/1950, Březnice 099. **N**: *Diceros bicornis michaeli*. Based on the characters given by Groves (1971) the horns certainly belong to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale known in *Diceros*. Accepting the geographic origin labelled, the specimen could be identified as *D. b. michaeli* (see Groves 1967a, 1972, Princ 1990, Hillman-Smith & Groves 1994).

NMP 57834; two well preserved, associated, relatively robust horns, with a wooden base; dark brown. The first horn is bent a little to the right at the apex. **O**: *Diceros bicornis*, Tana River, coll. Pálfy; determined by O. Štepánek; C2 -115-03a, 7028/1953, from state possession – NKK 8850/1950, Březnice 0100. **N**: *Diceros bicornis michaeli*. Based on the characters given by Groves (1971) the horns certainly belong to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale known in *Diceros*. Accepting the geographic origin labelled, the specimen could be identified as *D. b. michaeli* (see Groves 1967a, 1972, Princ 1990, Hillman-Smith & Groves 1994).

NMP 49256; well preserved formalin specimen of a newborn calf. **O**: *Diceros bicornis*, inv. no. 49256, obtained from the Dvůr Králové Zoo in 1999; a. n. 122/99. **N**: *Diceros bicornis michaeli*. Data on the individual (Holečková 2009): ♂ Jonáš (35/0/DK/18), captive born on 4 December 1995 (Dvůr Králové Zoo), died on 12 December 1995 (Dvůr Králové Zoo, weight 25 kg), Studbook No. 562 (ARKS 058035).

NMP 49257; well preserved formalin specimen of an aborted calf. **O**: *Diceros bicornis*, inv. no. 49257, obtained from the Dvůr Králové Zoo in 1999; a. n. 122/99. **N**: *Diceros bicornis michaeli*. Data on the individual (Holečková 2009): unnamed ♀ (DK 15, 31/0/DK/15), born dead on 11 April 1994 (Dvůr Králové Zoo, weight 24 kg), on the 427th day of gestation; Studbook No. 539 (ARKS 058031).

NMP 25963; well preserved skull with mandible, both premaxillae absent. Upper dentition: all molariforms fully erupted including both P^1 (two teeth) and P_1 (two alveoli); both M^3 and M_3 with advanced wear; one pair of alveoli is present in front of the lower molariforms – it is possible that one erupted pair

of incisors was present and later shed naturally. **O**: *Diceros bicornis michaeli*, ♂, 12 December 1969, from the Prague Zoo; a.n. 137/69. **N**: *Diceros bicornis michaeli*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (du Toit 1987a): XIV (18–24 years). However, the male was actually 17 years old according to the zoo evidence (for discussion see below). Additional data on the individual (Holečková 2009 and from the Prague Zoo): ♂ named Max 2 of unknown origin (East Africa), transferred to Prague Zoo on 24 October 1954, died on 24 September 1969 (Prague Zoo, TBC); Studbook No. 42.

NMP 25964; well preserved skull with mandible and with premaxilla (D) absent. Upper dentition: all molariforms fully erupted including both P^1; both M^3 with no wear. Lower dentition: six molariforms fully erupted; both M_3 with a little wear; both P_1 absent, but some indications of rudimentary alveoli are present in front of both P_2; one pair of alveoli is present in front of lower molariforms – it is possible that one erupted pair of incisors was present and later shed naturally. **O**: *Diceros bicornis michaeli*, ♂ King, approx. 7 years, wild born approx. in 1970 in Kenya, died on 27 April 1978, gift from the Dvůr Králové Zoo; a.n. 87/78. **N**: *Diceros bicornis michaeli*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (du Toit 1987a): X (6–12 years). However, the male was actually 8 years old according to the zoo evidence (for discussion see below). Data on the individual (Holečková 2009): wild born in 1970 in the Tsavo National Park (Kenya), transferred to the Dvůr Králové Zoo on 22 August 1971, died on 22 April 1978 (Dvůr Králové Zoo); Studbook No. 172 (ARKS 058003).

NMP 47655; well preserved complete disarticulated skeleton with corneous hooves; skull with premaxillae and mandible, auditory bulla (S) broken; two isolated horns. Upper dentition: six molariforms fully erupted; both P^1 absent. Lower dentition: six molariforms fully erupted, both P_1 absent; both M^3 and M_3 with advanced wear. Brown horns, apex of the first one divided, a small stone in a crevice. Boundary between horn base and stem hardly detectable. **O**: *Diceros bicornis michaeli*, Dvůr Králové Zoo; a. n. 6/97. **N**: *Diceros bicornis michaeli*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (du Toit 1987a): XIV (18–24 years). Considering the age estimation, accession number and breeding of this rhinoceros subspecies in the Dvůr Králové Zoo (Holečková 2009), the specimen could be associated with ♀ Jarča (Studbook No. 178, 1970–1996), ♀ Elvíra (DK 1, 244, 1977–1996) or ♂ Mabu (277, 1979–1996).

NMP 48347; well preserved skull with premaxillae, mandible and two isolated horns; well preserved formalin specimen of penis with adjacent tissues. Several associated disarticulated postcranial bones: hyoid bones, sacrum, 2 caudal and 3 lumbal vertebrae. Upper dentition: seven molariforms fully erupted including both P^1. Lower dentition: all six molariforms fully erupted (S); P_1 (S) absent, but alveolus is present in front of both P_2; the right mandible has a normal condition for the fourth premolar and all molars, but all teeth in front of the fourth premolar are deformed – four rounded abraded teeth are present; both M^3 and M_3 with advanced wear. The horns are robust and almost equally sized; pale brown with pale

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Figs. 9–12. Horn specimens of the African rhninoceroses from the NMP collection. 9 – *Diceros bicornis michaeli*, s.i.; NMP 57832. Lateral view of a horn pair; note the atypically shaped first horn. 10 – *Diceros bicornis*, ♂; NMP 57399. Lateral view of a horn pair; note the atypically shaped first horn. 11 – *Ceratotherium simum*, ♀; NMP 37572. Lateral view of an isolated horn; note the extremely long first horn. 12 – cf. *Ceratotherium simum*, s.i.; NMP 57827. Frontal view of an isolated first horn; note the asymmetrically shaped horn.

Obr. 9–12. Rohy afrických nosorožců ze sbírky Národního musea v Praze. 9 – boční pohled na pár rohů nosorožce dvourohého (východní poddruh *D. b. michaeli*) s nezvyklým tvarem prvního rohu. 10 – boční pohled na pár rohů samce nosorožce dvourohého (NMP 57399) s atypickým tvarem vrcholu prvního rohu. 11 – boční pohled na extrémně dlouhý první roh samice nosorožce tuponosého (NMP 37572). 12 – přední pohled na asymetrický první roh nosorožce tuponosého (NMP 57827).


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orange tint. Boundary between horn base and stem hardly detectable; several hairs detectable on horn base in the second horn. Hairs are observable on the skin bordering the penis. **O**: *Diceros bicornis*, ♂ Cody, captive born, Taronga Zoo, 19 May 1999, from the Dvůr Králové Zoo; a.n. 83/99. **N**: *Diceros bicornis michaeli*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (du Toit 1987a): XV (23–31 years). However, the male was actually 24 years (23 y, 11 m, 29 d) old according to the zoo evidence (for discussion see below). Additional data on the individual (Holečková 2009): captive born on 20 May 1975 (Sydney Zoo), transferred from the Berlin Zoo to the Dvůr Králové Zoo on 10 December 1992, died on 19 May 1999 (Dvůr Králové Zoo), Studbook No. 260 (ARKS 058029). Indication of traction epiphyses of the lachrymal tubercle (cf. Cave 1965) is present. One pair of *foramen parietale* (cf. Zeuner 1934: 69) is well expressed.

NMP 93519; well preserved skull with mandible; both premaxillae absent; deep groove in the interorbital region. Upper dentition: six molariforms fully erupted, including both P^1; both M^3 erupted, but not in occlusion; P^1 (D) absent. Lower dentition: five molariforms fully erupted; both M_3 erupted, nearly in occlusion. **O**: ♀, age 10–11 years, wild born in Kenya, captured on 22 August 1971, died on 26 June 1978; DVH 5-173, No. 172 on the skull. **N**: *Diceros bicornis michaeli*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 5; (du Toit 1987a): X (6–12 years). However, the female was actually 9 years old according to the zoo evidence (for discussion see below). Additional data on the individual (Holečková 2009): ♀ named Zina, wild born in the Tsavo National Park, Kenya, in 1969, transferred to the Dvůr Králové Zoo on 22 August 1971, died on 26 June 1978 (Dvůr Králové Zoo), Studbook No. 173 (ARKS 058005). The specimen possesses a bifid infraorbital foramen (bilaterally), atypically for the East African black rhinoceroses (Rookmaaker & Groves 1978, Hillman-Smith & Groves 1994).

NMP 93520; well preserved skull with mandible; both premaxillae absent. Upper and lower dentition: all molariforms fully erupted including both P^1 and P_1; P_1 (D) absent; both M^3 and M_3 with no wear. **O**: ♀, 10 years, wild born west of the Tsavo National Park, Kenya, transferred to the Dvůr Králové Zoo on 22 August 1971, died on 24 May 1978; DVH9-177, bloc 29, No. 165 on the skull. **N**: *Diceros bicornis michaeli*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (du Toit 1987a): X (6–12 years). However, the female was actually 10 years old according to the zoo evidence (for discussion see below). Additional data on the individual (Holečková 2009): ♀ named Tuty, Studbook No. 177 (ARKS 058010).

NMP 93521; well preserved skull with mandible; both premaxillae absent. Upper and lower dentition: all molariforms fully erupted including both P^1 and P_1; both M^3 and M_3 with no wear; P_1 (D) rudimentary; one pair of alveoli is present in front of the lower molariforms – it is possible that one erupted pair of incisors was present and later shed naturally. **O**: adult ♀, wild born in the Tsavo National Park, Kenya, died on 24 April 1981; 01/60/13, No. 489 on the mandible. **N**: *Diceros bicornis michaeli*. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (du Toit 1987a): X (6–12 years). However, the female was actually 8 years old according to the zoo evidence (for discussion see below). Additional data on the individual (Holečková 2009): ♀ named Satara, wild born in 1973, transferred from Kenya to the Dvůr Králové Zoo on 2 July 1974, then from 20 April 1976 to 14 July 1979 kept in the Lešná Zoo, and finally

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Figs. 13–16. *Ceratotherium cottoni*, live individuals in the Dvůr Králové Zoo (August 2007). 13 – ♀ Nesari; note the usual size and shape of the horns. 14 – ♂ Suni; note a slightly forward oriented curvature of the first horn and the usual shape of the second horn. 15 – ♀ Najin; note markedly forward oriented curvatures of both horns. 16 – ♀ Nabire; note markedly forward oriented curvatures of both horns.
Obr. 13–16. Doklad variability tvaru rohů u nosorožců Cottonových chovaných v lidské péči (srpen 2007, Zoo Dvůr Králové). 13 – samice Nesari s normálním tvarem obou rohů. 14 – samec Suni se slabým směřováním prvního rohu dopředu, ale normálním tvarem druhého rohu. 15 – samice Najin se směřováním obou rohů vpřed. 16 – samice Nabire s výrazným směřováním obou rohů dopředu.

from 14 July 1979 to 24 April 1981 back in the Dvůr Králové Zoo; Studbook No. 218 (ARKS 058013). Two relatively thin and long processes below the left condylar process; circular abscess approx. 1 cm long and 1.5 cm high, associated with approx. 6 cm long groove on the inner side of the right mandible (*ramus mandibulae*). Indication of traction epiphyses of the lachrymal tubercle (cf. Cave 1965) is present. This specimen possesses a bifid infraorbital foramen (D), atypical for the East African black rhinoceroses (Rookmaaker & Groves 1978, Hillman-Smith & Groves 1994).

HFM 376 (376/70); two pairs of well preserved, associated, relatively slender horns, with bordered skin sections and a wooden base; dark brown to black; many hairs detectable on the preserved skin (10–20 mm long). **O**: Bondoni (Kenya), 4 February 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: *Diceros bicornis michaeli*, based on the geographic origin (Groves 1967a, Hillman-Smith & Groves 1994).

HFM 377 (377/70); two well preserved, associated, relatively slender horns, with bordered skin sections and a wooden base; dark brown to black; several hairs detectable on the preserved skin (about 10 mm long). **O**: Nairobi River (Athi River near Nairobi) (Kenya), 19 February 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: *Diceros bicornis michaeli*, based on the geographic origin (Groves 1967a, Hillman-Smith & Groves 1994).

HFM 411 (411/70); two pairs of well preserved, associated, relatively robust horns, with bordered skin sections and wooden base; dark brown; several hairs detectable on the preserved skin. The first horn of the pair of longer horns with a blunt apex. **O**: Athi River (Kenya), 20 February 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: *Diceros bicornis michaeli*, based on the geographic origin (Groves 1967a, Hillman-Smith & Groves 1994).

HFM 412 (412/70); two well preserved, associated, relatively slender horns, with bordered skin sections and a wooden base; dark brown; many hairs detectable on the preserved skin (about 10 mm long). **O**: Athi plains (Kenya), 5 March 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: *Diceros bicornis michaeli*, based on the geographic origin (Groves 1967a, Hillman-Smith & Groves 1994).

HFM 413 (413/70); two well preserved, associated, relatively slender horns, with bordered skin sections and a wooden base; dark brown. **O**: Athi plains (Kenya), 9 February 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: *Diceros bicornis michaeli*, based on the geographic origin (Groves 1967a, Hillman-Smith & Groves 1994).

HFM 414 (414/70); two well preserved, associated, relatively robust horns, with bordered skin sections and a wooden base; dark brown to black; several hairs detectable on the preserved skin. **O**: Bondoni (Kenya), 11 March 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: *Diceros bicornis michaeli*, based on the geographic origin (Groves 1967a, Hillman-Smith & Groves 1994).

HFM 417 (417/70); three well preserved pairs of associated, relatively slender horns, with bordered skin sections and a wooden base; dark brown. The second horn of the medium-sized pair with a broken apex. **O**: Athi plains (Kenya), 2 March 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: *Diceros bicornis michaeli*, based on the geographic origin (Groves 1967a, Hillman-Smith & Groves 1994).

HFM 419 (419/70); three well preserved pairs of associated, relatively slender horns, with bordered skin sections and a wooden base; dark brown; several hairs (10–20 mm long) detectable on the preserved skins. **O**: Athi plains (Kenya), March 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: *Diceros bicornis michaeli*, based on the geographic origin (Groves 1967a, Hillman-Smith & Groves 1994).

HFM 785 (4/63); two well preserved, associated, relatively slender horns, with bordered skin sections and a wooden base; dark brown to black. **O**: Athi plains (Kenya), 12 February 1896, leg. Hans Lichtenstein;

Diceros bicornis (revised by Hanák et al. 2003). **N**: *Diceros bicornis michaeli*, based on the geographic origin (Groves 1967a, Hillman-Smith & Groves 1994). Hanák et al. (2003) also mentioned a mounted head skin besides the horns, however, only two horns are kept under this collection item.

HFM 787 (6/63); well preserved mounted head skin with two relatively slender, dark brown horns. **O**: Bondoni (Kenya), 4 February 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: *Diceros bicornis michaeli*, based on the geographic origin (Groves 1967a, Hillman-Smith & Groves 1994).

HFM 789 (8/63); two well preserved, associated, relatively slender horns, with bordered skin sections and a wooden base; dark brown to black; several hairs detectable on the preserved skin. **O**: Nairobi River (Athi River near Nairobi) (Kenya), 21 March 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: *Diceros bicornis michaeli*, based on the geographic origin (Groves 1967a, Hillman-Smith & Groves 1994).

ZMP, unnumbered [for purposes of this catalogue tentatively numbered as ZMP *Diceros* 02]; well preserved skull with premaxillae and mandible. Upper and lower dentition: all molariforms fully erupted including both P^1 and P_1; both M^3 and M_3 with a little wear. Both premaxillae possess one incisor alveolus, the right alveolus contains an incisor. The mandibula also possesses one pair of alveoli with incisors. **O**: *Diceros bicornis michaeli*, from the Dvůr Králové Zoo, 2009. **N**: *Diceros bicornis michaeli*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (du Toit 1987a): XIII (13–19 years). However, the female was actually 15 years old according to the zoo evidence (for discussion see below). Additional data on the individual (Holečková 2009): ♀ named Jiddah (DK17), captive born on 15 November 1994 (Dvůr Králové Zoo), died on 25 December 2009 (Dvůr Králové Zoo, euthanasia, kidney disfunction), Studbook No. 540 (ARKS 058033). The specimen possesses a bifid infraorbital foramen (bilaterally), atypical for the East African black rhinoceroses (Rookmaaker & Groves 1978; Hillman-Smith & Groves 1994).

ZMP, unnumbered; well preserved skull with premaxillae and mandible. Upper dentition: six molariforms fully erupted; both M^3 with heavy wear; P^3 (D) absent. Lower dentition: six molariforms fully erupted; both M_3 with advanced wear; P_3 (S) absent, and P_2 (S) present, but in a form of a narrow circular knob. **O**: *Diceros bicornis michaeli*, ♀ Jimmi, from the Dvůr Králové Zoo. **N**: *Diceros bicornis michaeli*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (du Toit 1987a): XV (23–31 years). However, the female was actually 39 years old according to the zoo evidence (for discussion see below). Additional data on the individual (Holečková 2009): wild born in Kenya in 1970, transferred to the Dvůr Králové Zoo on 22 August 1971, died on 21 August 2009 (Dvůr Králové Zoo), Studbook No. 175 (ARKS 058008). Condylar mandibular processes seem to be narrower than usual (due to an arthrosis?) and the upper molariforms are mineralized at labial surfaces.

Zoo-Dvur, unnumbered; well preserved skull with mandible, both premaxillae absent. Upper dentition: all molariforms fully erupted including both P^1; both M^3 with moderate wear. Lower dentition: all molariforms fully erupted including one P_1 (S); both M_3 with advanced wear. **O**: *Diceros bicornis michaeli*, ♀ Sali. **N**: *Diceros bicornis michaeli*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (du Toit 1987a): XIV (18–24 years). However, the female was actually 28 years old according to the zoo evidence (for discussion see below). Additional data on the individual (Holečková 2009): ♀ named Sali (DK2), captive born on 5 July 1978 (Dvůr Králové Zoo), died on 25 February 2006 (Dvůr Králové Zoo), Studbook No. 282 (ARKS 058015). The specimen possesses a bifid infraorbital foramen (bilaterally), atypical for the East African black rhinoceroses (Rookmaaker & Groves 1978; Hillman-Smith & Groves 1994).

Zoo-Dvur, 105892; well preserved skull with premaxillae and mandible. Upper dentition: all molariforms fully erupted including one P^1 (D); both M^3 with moderate wear. Lower dentition: all molariforms fully erupted including one P_1 (S); both M_3 with a little wear. **O**: *Diceros bicornis michaeli*, unknown individual.

N: *Diceros bicornis michaeli*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (du Toit 1987a): XII (9–15 years).

Zoo-Dvur, 10664; well preserved skull with premaxillae and mandible. Upper and lower dentition: all molariforms fully erupted, including both P^1 (but only the left tooth is present) and I_1 (S); M^3 with slight wear, M_3 with no wear. **O**: ♀ Elsa, wild born in Kenya, captured on 22 August 1971, died on 7 April 1978; old number: 162. **N**: *Diceros bicornis michaeli*. Cranial sutures closed. Age estimation based on teeth eruption and wear (Groves 1967b): stage 6; (du Toit 1987a): XI (7–13 years). However, the female was actually 7 years old according to the zoo evidence (for discussion see below). Additional data on the individual (Holečková 2009): Studbook No. 174 (ARKS 058006). One small circular hole is present on the upper edge of *foramen magnum*.

Diceros bicornis minor (Drummond, 1876)

NMP 57399; two well preserved, relatively slender horns on the nasal portion of skull, with a wooden base (Fig. 10); dark brown. Apex of the first horn not pointed, but rounded. **O**: *Diceros bicornis*, ♂, Nord-Ost-Rhodesia, 19 July 1923; Březnice 0280, C2-115-A03, 103/2004, origin unknown. **N**: *Diceros bicornis minor*. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the variation scale known in *Diceros*. Accepting the geographic origin labelled, the specimen could be identified as *D. b. minor* (see Groves 1967a, Hillman-Smith & Groves 1994).

Dicerotinae sp.

NMP 37572; well preserved, extremely long and relatively slender horn, probably the first one, with a gypsum base (Fig. 11); dark brown. **O**: *Ceratotherium simum*, ♀, South Africa, 1869; 25/80, C2-315-R02; 0110/2005, unknown origin. **N**: Dicerotinae sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale of *Diceros*. Accepting the origin and identification labelled above, the specimen represents the sixth longest horn of *Ceratotherium simum* in the world (see Discussion below). A worn old label containing a German writing is associated with the horn, an attempt to decipher the text (courtesy of D. Kovář, České Budějovice District Archive, České Budějovice) could be interpreted as follows: "this horn belongs to an extraordinarily large individual shot in Java. The horn was delivered *via* a ship that voyaged around the world, it anchored in Honolulu in 1869. This horn was bought by dr. Friedl for an exhibition in Vienna." The original labellings are incongruent (Africa *vs*. Java origins). However, the horn certainly originates from an African rhinoceros based on morphological evidence.

NMP 54481; well preserved, extremely long and relatively slender horn, certainly the first one; with a wooden base; brown. A shallow hollow above the horn base and two longitudinal grooves on the anterior side of the horn are present. **O**: *Rhinoceros unicornis*, Das indische Nashorn, Das Horn, donated by Mr. Kareš from Brehmen, 1884; C2-315-R01; P6r-10/86-58. **N**: Dicerotinae sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale of *Diceros*. The original determination is erroneous; C. P. Groves (in litt.) kindly helped us with the determination: "NMP 54481 is a magnificent specimen, […] it is certainly [an] African [rhinoceros], and could be either White or Black."

NMP 57254; two well preserved, associated, relatively robust and similarly sized horns, with bordered skin sections and a wooden base; dark brown. Partly (naturally) broken apex of the first horn. **O**: *Diceros bicornis*, Migungami, 3 October 1910, leg. Böhm; C2-115-03a, 7008/1953, 0072/2004, from the Böhm state possession, Těchlovice. **N**: Rhinocerotidae sp. Based on the characters given by Groves (1971) it

certainly belongs to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*. If Migungami corresponds with Mikunguni/Mikinguni (05° 32' S, 38° 56' E) in Tanzania, we could identify this specimen as *D. b. minor* (Groves 1967a, Hillman-Smith & Groves 1994).

NMP 57261; two well preserved, associated, relatively slender horns, with a wooden base; dark brown to black. **O**: Rhinocerotidae sp., (Tanzania); C2-115-03a, 16/1963, 0081/2004; unknown origin, from the Ohrada [Castle] collection. **N**: Dicerotinae sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of the first horn base shows to *Ceratotherium* sp. However, the Tanzanian origin labelled is not congruent with such identification (cf. Schomber 1966). We therefore tend to identify the specimen as Dicerotinae sp. only.

NMP 57666; well preserved isolated horn with a relatively robust stem; black. A shallow longitudinal groove on the anterior side of the horn is visible. **O**: Rhinocerotidae sp.; C2-315-R02, 0110/2005, origin unknown (evidence lost after the WWII). **N**: Dicerotinae sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale of *Diceros*.

NMP 57830; two well preserved associated horns bordered by skin sections; dark brown. Boundary between the horn base and stem hardly detectable in both horns; several hairs detectable on the horn base and associated skin sections (4–10 mm long). **O**: Rhinocerotidae sp., juv.; C2-315-R01, 0006/2006, unknown origin. **N**: Dicerotinae sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base shows to *Diceros*, but the specimen probably is a juvenile and the identification should be considered rather tentative.

NMP 57837; well preserved, isolated, relatively slender horn, probably the second one; dark brown to black. **O**: Rhinocerotidae sp.; C2-315-R01, 0006/2006, origin unknown, old collection, evidence lost. **N**: Dicerotinae sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale of *Diceros*.

NMP 57838; well preserved, isolated, relatively robust horn, probably the second one; chestnut brown. **O**: Rhinocerotidae sp.; C2-315-R01, 0006/2006, origin unknown, old collection, evidence lost. **N**: Dicerotinae sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale of *Diceros*.

NMP 57839; well preserved, isolated, relatively slender horn, probably the first one; chestnut brown. **O**: *Diceros bicornis*; C2-315-R01, 0006/2006, origin unknown, old collection, evidence lost. **N**: Dicerotinae sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale of *Diceros*.

NMP 57840; well preserved, isolated, relatively robust horn, certainly the first one; chestnut brown. Small skin section is associated with the posterior part of horn base, several hairs are detectable on posterior side of horn base. **O**: *Diceros bicornis*; C2-315-R01, 0006/2006, origin unknown, old collection, evidence lost. **N**: Dicerotinae sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale of *Diceros*.

NMP 57841; well preserved, isolated, relatively slender horn, probably the first one; greenish grey to brown. **O**: Rhinocerotidae sp. – *Ceratotherium simum*?; C2-315-R01; 0006/2006, origin unknown, old collection, evidence lost. **N**: Dicerotinae sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base shows to *Diceros*, but the specimen probably is a juvenile and the identification should be considered rather tentative.

NMP 57842; poorly preserved, isolated, relatively slender horn, certainly the second one, bordered by skin sections including that for the first horn; dark brown to black. Many hairs detectable on the horn bases (5–8 mm, the longest 16 mm). **O**: Rhinocerotidae sp. – *Ceratotherium simum*?; C2-315-R01; 0006/2006, origin unknown, old collection, evidence lost. **N**: Dicerotinae sp. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the typical variation scale of *Diceros*.

cf. *Dicerorhinus sumatrensis* (Fischer, 1814)

NMP 49731; well preserved isolated horn, probably the first one; rather slender with an isolated circle base (97 mm long, 88 mm wide, 21 mm high); dark brown. Boundary between horn base and stem slightly undetectable. **O**: Rhinocerotidae sp.; 72/61, handed from the Náprstek Museum in 1961, deposited in the osteological collection, rhinoceros n. 12. **N**: Rhinocerotinae, cf. *Dicerorhinus sumatrensis*. Based on the characters given by Groves (1971) it certainly belongs to Rhinocerotinae. C. P. Groves (in litt.) kindly helped us with the determination: "It is quite possible that NMP 49731 could be a Sumatran rhino: remember that, until well into the 20th century, this was not a particularly rare species. But the manner in which it is worn suggests it is from captivity: the tip is blunt, and does not taper."

Rhinoceros unicornis Linnaeus, 1758

NMP 50026; well preserved complete juvenile skeleton; left femur cut lengthways to two halves; unossified nasal septum approx. 3 mm wide. Upper dentition: two pairs of very small incisors present; only two pairs of molariforms fully erupted (second and third premolars?) one pair of antecedent and successive molariforms erupted, but not in occlusion. Lower dentition: one incisor pair present; only three molariforms fully erupted (first to third premolars?); two successive molariforms erupted, but not in the occlusion position. **O**: *Rhinoceros unicornis*, juvenile ♀ Nelly, captive born (Dvůr Králové Zoo) on 14 January 1986, died on 27 February 1986 (Dvůr Králové Zoo); a.n. 44/86. **N**: *Rhinoceros unicornis*. Cranial sutures open. Age estimation based on teeth eruption and wear (Groves 1967b): stage 1. Additional data on the individual (Holečková 2009): number 3/0/DK/1, artificial rearing, died due to a bacterial infection.

HFM 839 (58/63, skull), **840** (59/63), **841** (60/63); well preserved skull (No. 839) with premaxillae and mandible (mounted by iron wires); a hole present above the left orbit; several teeth are absent: I_1 (S), lower C (S), and all upper premolars. Upper and lower dentitions: five molariforms fully erupted; both M^3 erupted, but not in the occlusion position; both rudimental P_1 present. Remains of the nasal septum are preserved on the ventral surface of nasal bones. An isolated well preserved, relatively robust and short horn (No. 840); dark brown to black, with pale brown apex. Relatively short horn base observable. An isolated well preserved, relatively slender and very long horn (No. 841); dark brown to black; a shallow longitudinal groove is present on the anterior side of the horn. **O**: 1896, leg. Hans Lichtenstein; *Diceros bicornis* (revised by Hanák et al. 2003). **N**: *Rhinoceros unicornis*. Cranial sutures relatively open. Age estimation based on teeth eruption and wear (Groves 1967b): stage 5. Hanák et al. (2003) associated these three items with one individual of *Diceros bicornis*, but we cannot not agree with such a statement, as the HFN 839+840 specimens are certainly not African rhinoceroses. We determined both specimens as *Rhinoceros unicornis* based on skull and horn characters. On the contrary, specimen HFN 841 belongs certainly to Dicerotinae, perhaps to *Ceratotherium* sp. based on the anteroposterior diameter of horn base.

cf. *Rhinoceros unicornis* Linnaeus, 1758

NMP 93522; isolated tooth, partly damaged. Greatest length: 58 mm, greatest width 47 mm, greatest crown height 42 mm, root length 37 mm. **O**: *Rhinoceros*, 164 g. **N**: Although we were not able to determine the taxon and an exact tooth position in the upper jaw, C. P. Groves (in litt.) kindly helped us with the identification: " [the tooth] is very obviously different. It has been left out in the weather for a long time,

and is very damaged, but there seems to have been a medisinus (much of the crista and crochet fusion complex, which surrounds the medisinus anterolingually, has been broken away, but I think I can see it basally). If this is right, this supports the evidence of a very smooth, rounded ectoloph in suggesting that it is *R. unicornis*. As for the position in the toothrow, this is very difficult. In particular, it is difficult to distinguish P^4, M^1 and M^2, so I would hazard a guess that specimen 2 might be P^4."

Rhinocerotinae sp.

ZMP, unnumbered; well preserved, isolated, robust horn, perhaps the first one; pale brown. Boundary between the horn base and stem hardly detectable; horn with several narrow lines across all sides, one transverse blunt line on the left side near the apex and two transverse sharp lines on the right side. **O**: *Rhinoceros unicornis*; unknown origin. **N**: Rhinocerotinae sp. Based on the characters given by Groves (1971) it certainly belongs to Rhinocerotinae, perhaps to *Dicerorhinus* or *Rhinoceros unicornis*, but not to *R. sondaicus*. Morphology of the horn is markedly changed due to abrasion typical for captive rhinoceroses.

Rhinocerotidae sp.

NMP P6p-7028/1953; poorly preserved, mounted distal part of a rhinoceros limb in a form of ashtray; one great crack on the posterior and ventral sides. **O**: *Rhinoceros* sp. or *Diceros bicornis*, ashtray, N. coll. 110, leg. Pálfy, Březnice, 33/2008. **N**: We were not able to determine this specimen, we tend to use a tentative Rhinocerotidae-identification for the disunity of diagnoses on original labels.

NMP P6r-1986/10 (99); two associated rhinoceros horns. **O**: unknown. **N**: identified as Rhinocerotidae, not revised. Currently placed in a permanent exhibiton in the Vlašim Castle (Central Bohemia).

NMP P6j-1988/4; mounted distal part of a rhinoceros limb in a form of ashtray. **O**: unknown. **N**: identified as Rhinocerotidae, not revised. Currently placed in a permanent exhibiton in the Vlašim Castle (Central Bohemia).

NMP P6j-1988/17, P6j-1989/073b; **t**wo rhinoceros tails. **O**: unknown. **N**: identified as Rhinocerotidae, not revised.

NMP P6j-1988/18; an inkpot from a rhinoceros limb. **O**: unknown. **N**: identified as Rhinocerotidae, not revised.

NMP P6j-1988/19; a box from a rhinoceros limb. **O**: unknown. **N**: identified as Rhinocerotidae, not revised.

NMP P6j-1989/73; a rhinoceros tail. **O**: *Diceros bicornis*, unknown; from the Pálfy state possession, Březnice. **N**: identified as Rhinocerotidae, not revised.

NMP 56148; two rhinoceros horns. **O**: *Diceros bicornis*, Kim, February 1905, coll. Pálfy; 7028/1953, from the Pálfy state possession, Březnice. **N**: Rhinocerotidae sp. Association of the locality of origin with a specific region of Africa is difficult, the specimen remains unidentified. However, with a certain speculation we could note that all the exactly localised specimens collected by Pálfy are associated with Kenya (see above). Thus, the specimen perhaps belongs to *Diceros bicornis* (*D. b. ladoensis*, *D. b. michaeli* or *D. b. minor*; cf. Groves 1967a, Hillman-Smith & Groves 1994).

NMP 57667; well preserved, isolated, relatively robust horn, probably the second one. **O**: Rhinocerotidae sp.; C2-315-R02, 0110/2005, origin unknown, evidence lost (after the WWII). **N**: Rhinocerotidae sp. Based on the characters given by Groves (1971), the identification is uncertain, concerning the specific characters. The horn surface seems to be artificially changed or modified by captivity conditions.

NMP 57826; well preserved, isolated, robust horn, perhaps the first one; grey to pale brown. Boundary between the horn base and stem hardly detectable. **O**: *Ceratotherium simum*; unknown origin (probably

from a zoo), C2-315-R01, 0006/2006. **N**: Rhinocerotidae sp. Based on the characters given by Groves (1971), the specimen remains indeterminable. The horn surface seems to be artificially changed or modified by captivity conditions. Its external appearance (shape, colour) is very similar to the horns of *Ceratotherium cottoni* originating from the Dvůr Králové Zoo. The specimen perhaps originated from the same individual as the NMP 57828 horn.

NMP 57827; well preserved, isolated, robust horn, probably the first one (Fig. 12); pale brown to chestnut brown. Boundary between the horn base and stem hardly detectable; horn markedly bent to the right from the base to apex; several hairs are detectable on the horn base (to 20 mm). **O**: *Ceratotherium simum*; unknown origin (probably from a zoo), C2-315-R01, 06/2006. N: Rhinocerotidae sp. Based on the characters given by Groves (1971), it remains indeterminable. The horn surface seems to be artificially changed or modified by captivity conditions.

NMP 57828; well preserved, isolated, robust horn, perhaps the second one; gray to pale brown. Boundary between the horn base and stem hardly detectable; three sharp horizontal lines on the anterior side. **O**: *Ceratotherium simum*; unknown origin. N: Rhinocerotidae sp. Based on the characters given by Groves (1971), it remains indeterminable. The horn surface seems to be artificially changed or modified by captivity conditions. The external appearance (shape, colour) is very similar to horns of *Ceratotherium cottoni* originating from the Dvůr Králové Zoo. The specimen perhaps originated from the same individual as the NMP 57826 horn.

NMP 93523; incomplete postcranial skeleton incl. pelvis, several vertebrae and one autopodium. **O**: absent, from the Dvůr Králové Zoo (?). **N**: Rhinocerotidae sp.

HFM 855 (74/63); two well preserved, mounted distal parts of rhinoceros limbs in a form of table(?); some cracks on the posterior sides in both specimens. **O**: *Diceros bicornis* (revised by Hanák et al. 2003). **N**: we cannot confirm the identification by Hanák et al. (2003), however, we have no objectives against their conclusion that the specimen belongs to the family Rhinocerotidae.

DISCUSSION

Nature of collections

In summary, seven collections (NMP, IAMF, ISZ, HFM, ZMP, Zoo-Dvur, Zoo-Ostrava) contained 186 specimens and 190 collection items of tapirs and rhinoceroses, representing at least two species of tapirs and five species of rhinoceroses (Grubb 2005, Groves et al. 2010); in addition, a crossbred of *Ceratotherium simum* and *C. cottoni*; see Table 4.

Most of the collections revised were not created as a systematic ceratomorph collection. Only two collections, NMP and ZMP, have stored wild- or captive-born individuals of tapirs and rhinoceroses systematically. Only the HFM collection consists purely of specimens originating from wild individuals, on the other hand, they are represented by horn trophies only. Unfortunately, such collection practice was common among hunters (Rookmaaker 2007, Groves 2008).

A large portion of the NMP tapir specimens was originally a property of the famous nature products trading company carried by Václav Frič (1839–1916) from Prague (brother of a famous zoologist Professor Antonín Frič), and was bequeathed to the National Museum by Frič's nephew Jaroslav (Štěpánek 1975). This selection was not primarily created as a scientific collection and the specimens mostly lacked data on their origin and taxonomic affiliation. Many collection items in the National Museum were cumulated due to state confiscations in the post-WWII period. More recently, additional material was obtained due to close cooperation between the National Museum and some zoological gardens in the last three decades, especially the Dvůr Králové and Prague Zoos. The history of the IAMF collection was summarised by Seichert et

Table 4. Numbers of ceratomorph specimens in the collections revised
Tab. 4. Počet ceratomorfních kopytníků v revidovaných sbírkách

taxon	NMP	IAMF	ISZ	HFM	ZMP	Dvur	Ostrava	total
Tapirus indicus	7	–	–	–	1	–	–	8
Tapirus terrestris	30	1	1	–	1	–	–	33
cf. *Tapirus terrestris*	4	1	–	–	–	–	–	5
Tapirus sp.	46	1	–	–	–	–	–	47
Ceratotherium simum	2	–	–	–	4	–	1	7
Ceratotherium cottoni	4	–	–	–	–	–	–	4
Ceratotherium crossbred	–	–	–	–	1	–	–	1
Ceratotherium sp.	1	–	–	–	–	–	–	1
cf. *Ceratotherium*	1	–	–	–	–	–	–	1
Diceros bicornis	11	–	–	5	1	–	–	17
cf. *Diceros bicornis*	1	–	–	–	–	–	–	1
Diceros bicornis michaeli	12	–	–	11	2	3	–	28
Diceros bicornis minor	1	–	–	–	–	–	–	1
Dicerotinae sp.	12	–	–	1	–	–	–	13
cf. *Dicerorhinus sumatrensis*	1	–	–	–	–	–	–	1
Rhinoceros unicornis	1	–	–	1	–	–	–	2
cf. *Rhinoceros unicornis*	1	–	–	–	–	–	–	1
Rhinocerotinae sp.	–	–	–	–	1	–	–	1
Rhinocerotidae sp.	13	–	–	1	–	–	–	14
total / úhrnem	148	3	1	19	11	3	1	186

al. (2006). In general, it was created by fusion of the collections of two Institutes of Anatomy of the Czech (tentatively abolished in 1939) and German (finally abolished in 1945) Faculties of Medicine of the Charles University, in 1940. The collections were represented by sets of comparative preparations without zoological documentation in both institutions, and moreover, the final collection was seriously damaged by war incidents in 1945; thus, closer data on the IAMF items are absent (Seichert et al. 2006). The ISZ collection also has a composite character. It was complemented occasionally and over a long time.

The history and catalogue of the HFM collection was published by Hanák et al. (2003). In general, it is associated with the rich private natural history collection accumulated by Johann the II Lichtenstein in Úsov. The zoological collection consists of 2619 specimens of 518 species (Hanák et al. 2003). Considering African mammals of this collection, they are connected with safari trips carried out by Heinrich Lichtenstein (seven trips to Kenya and Sudan in 1881, 1896, 1899, 1900, 1901, 1902, 1906), Hans Lichtenstein (one trip to Kenya and Tanganyika in 1934), and by Ferdinand Andreas Lichtenstein (one trip to Kenya in 1939). All the HFM trophies were prepared by the companies Brüder Hodek (Vienna), Franz Kalkus (Vienna), or Lurysle (London).

The ZMP collection is a newly founded private institution associated with the Protivín Crocodile Zoo and the enthusiastic activities by Miroslav Procházka. The collection now comprises more than 1200 specimens, mostly vertebrates. The ZMP collection of ceratomorphs has a certain scientific value, as it contains several specimens of rare rhinoceros forms (including the only known crossbred of white rhinoceros species).

Scientific value of the NMP collection

Old specimens are numerous in the NMP collection, but an abundant absence of the information concerning their geographical origin strongly decreases the scientific value of the collection. Absence of detailed data on rhinoceros horns (and some other specimens) is caused by chaotic state confiscations after the WWII and inadequate storing of the specimens and their evidence. Close cooperation between the National Museum and the Dvůr Králové and Prague Zoos provided the NMP collection with valuable scientific specimens. Particularly the Dvůr Králové Zoo has been successful for a long period (that started in the 1960s) in keeping and reproduction of several species of rhinoceroses, including probably the rarest *Ceratotherium cottoni*. Such material is of a high scientific value, because it is associated with known history of the particular individuals, moreover, coming from the wild in most cases. Considering that all ceratomorphs are regarded more or less critically endangered animal species (see e.g. Brooks et al. 1997, Foose & van Strien 1997, Emslie & Brooks 1999), storing of even though captive individuals in the NMP has a great significance. Generally, individuals from captivity are not too frequently stored in museums and are often irrecoverably lost (see Groves 1982 for the Asian rhinoceroses). Such specimens – besides their undeniable documentation significance – could be useful for calibrations of age estimation (see e.g. Salas 2003, Hillman-Smith et al. 1986b, de Toit 1987a) and for detections of some morphological changes due to the captivity conditions (see e.g. Groves 1966, 1982). Many NMP tapir skulls are broken in the occipital region, they however remain useful for morphological comparisons as well as rhinoceros horns of different shapes and origins (wild or captive born individuals) (cf. Hieronymus et al. 2006). The abort and juvenile individuals (*Tapirus terrestris*, NMP 24764; *Rhinoceros unicornis*, NMP 50026) are useful for ontogenetic comparisons (cf. Schinz 1937).

Considering the rhinoceros horn length, two NMP specimens are of particular interest:

(1) NMP 37572: *Ceratotherium simum*, obtained from South Africa in 1869. The outer length is 1095 mm; the horn therefore represents the sixth longest horn of *C. simum* s.str. in the world. This fact was found to be noted in the Museum copy of the book "*Rowland Ward's Records of Big Game*" (Best et al. 1969) as a pencil written note by Vratislav Mazák (1937–1987, former NMP curator and eminent mammal taxonomist), but this observation was never published.

(2) NMP 54481: originally reported as *Rhinoceros unicornis*, but here identified as Dicerotinae sp. The outer length is 892 mm. The horn could represent the 24th longest horn of *Ceratotherium cottoni*, or 13th longest horn of *C. simum*, or 28th longest horn of *Diceros bicornis* in the world (cf. Best et al. 1969).

Abnormal morphology and pathology

Traction epiphyses rank among usual elements of the mammalian skull, as Cave (1965) clearly pointed. We detected presence or indications of the lachrymal epiphyses in several tapir and rhinoceros specimens; presence: *Tapirus terrestris* NMP 90116, 93439, 93444, 93446, 93451; *Ceratotherium simum* NMP 93509; *C. cottoni* NMP 93511; *Diceros bicornis* NMP 93515; indication: *T. indicus* NMP 46459, 93437; *T. terrestris* NMP 90115, 93441, 93444, 93445, 93453, 93457, 93458, IAMF 226; *Ceratotherium cottoni* NMP 93510; *Diceros bicornis* NMP 10657, 48347, 93516, 93521. We detected a relatively high frequence of traction epiphyses in tapirs, probably due to the juvenile/subadult age of the NMP specimens.

The most obvious anomaly found in the examined specimens was an extensive deformation of the left mandible in *T. indicus* (Fig. 2; NMP 93437). Mandibular actinomycosis was tentatively identified as a causer of the deformation (V. Páral, University of Veterinary and Pharmaceutical Sciences, Brno, ad verb.), however, an eventual identification with the help of histological investigation is not possible in this specimen.

We did not observe the dental anomaly in tapirs mentioned by Hooijer (1961) – the very distinct P^1 shape, however, we observed several other anomalies, mainly in the rostral region of maxilla and mandible (for details see the respective specimens): *Tapirus indicus* (NMP 47213) exhibits oligodonty (absence of one pair of incisors/alveoli); *T. indicus* (NMP 46459) shows an absence of one lower incisor alveolus; *Tapirus terrestris* (NMP 46078) shows an additional alveolus distally next to the upper canine, which was shifted in the mesial direction; *T. terrestris* (NMP 93438) exhibits a smaller lower canine and its shift in the distal direction; *T. terrestris* (NMP 93445) has a long and narrow tooth (incisor) on the lingual surface of the mandibular symphysis; and *T. terrestris* (ZMP, unnumbered) a healed fracture and a bulge on the labial surface of the mandibular symphysis. One can speculate that a relative high abnormality incidence in the rostral region in contrast with the molariform teeth could be associated with a less important function of these teeth for feeding and mastication and therefore a rather mild selection pressure.

We also detected some dental/skeletal anomalies or pathological changes in rhinoceros specimens: *Ceratotherium simum* (NMP 21896) possesses a healed abscess on the labial surface of the right mandible; *D. bicornis* (NMP 48347) a partial deformation of the right toothrow; *Diceros bicornis* (NMP 93521) an abscess on the lingual surface of the right mandible and also two supernumerary thin and relatively long processes on the condylar process. A thin and short process was also detected in an old wild born *Ceratotherium simum* (ZMP unnumbered). Some modifications caused by progressive arthrosis were detected in *Ceratotherium simum* (Zoo-Ostrava) and *D. bicornis* ♀ Jimmi (ZMP unnumbered). An anteroposterior compression of specific teeth and an extreme wear of some premolars were found in two *Ceratotherium simum* specimens from the Ústí nad Labem Zoo (♀ Saša and ♂ Dan, ZMP unnumbered). We did not detect any type of skull injuries similar to those observed and described by Garutt (1999) and/or Diedrich (2008).

Captivity-induced changes in horn morphology

Marked captivity-induced morphological changes in body size and skull morphology were documented in some rhinoceros species (Goddard 1970, Groves 1982, Dinerstein 1991). However, in horn morphology, such type of changes was found in all kept rhinoceros species (Groves 1971). In some aspects, our observations conform to those by Groves (1971). We were not able to detect an accurate boundary between the horn base and stem in some captive specimens (NMP 47145, 47655, 48347, 57827, 57828) and even the horn position in some cases (NMP 57826, 57828). We observed a considerable variation in horn shapes among captive rhinoceroses, but the horns from certain individuals of *Ceratotherium cottoni* from the Dvůr Králové Zoo are probably the most appreciable. Wild born individuals (Nesari, Saut, Sudan) showed both horns of the usual natural shapes, some captive born individuals (Suni, Nasi) had slightly forward-curved first horns, while others (Nabire, Najin, Fatu) showed markedly forward-curved first and second horns (see Figs. 13–16). It should be mentioned that horn shape could vary in captive individuals also throughout their life span (Bigalke 1945, Holečková 2009). Some individuals come to be indeterminable on the basis of photographic evidence, even by

experienced zoo keepers. Such a situation argues for a careful evidence of zoo kept individuals, useful also for zoological studies.

Calibration of age estimation

As already mentioned, age determination in tapirs is not an easy task, which remains unresolved despite several attempts (Maffei 2003, Salas 2003). Based on examination of three NMP specimens of *Tapirus indicus* of the known age, we can state that the age determination designed for *T. terrestris* by Maffei (2003) is not applicable for *T. indicus*. We identified great disproportions between the estimated and known ages: 8 years estimated vs. 26 years actually (NMP 46459), 6–8 vs. 21 years (NMP 47213), and less than 2 vs. 5–6 years (NMP 93437). However, whether the Maffei's (2003) criteria are not applicable for *T. indicus* as a species or only for captive individuals with a perhaps less abrasive diet, remains unknown.

Known ages of six captive individuals of *Diceros bicornis* (NMP 48347, 48347, 93519, 93520; ZMP unnumbered [Jiddah]; Zoo-Dvur 106664) seem to be well concordant with age estimations proposed by du Toit (1987a), only one individual (NMP 47655) seems to be much older according to the estimation after du Toit's criteria: 18–24 years estimated vs. 15 years actually. The specimen NMP 25963 seems to be slightly older according to the estimation: 18–24 years est. vs. 17 years actually. On the contrary, two individuals (♀ Jimmi, ZMP unnumbered; ♀ Sali, Zoo-Dvur unnumbered) were much older than their age estimations suggest: 18–24 est. years vs. 28 actual years (Sali), and 23–31 vs. 39 (Jimmi). Conversely, nearly all captive *Ceratotherium* individuals seemed to be younger according to the estimation designed by Hillman-Smith et al. (1986b). We identified disproportions between age estimations and known ages: *Ceratotherium cottoni*, NMP 47115: 14–20 years estimated versus 40 years actually; NMP 47145: 14–20 vs. 27 years; NMP 93512: 14–20 vs. 34 years; ♀ crossbred of *C. simum* × *C. cottoni*: 14–20 vs. 30 years (all from the Dvůr Králové Zoo). *Ceratotherium simum*: ♀ Dinah (Ostrava Zoo): 20–28 years estimated vs. 38 years actually; ♂ Dan (Ústí nad Labem Zoo): 25–32 vs. 38 years; ♀ Saša (Ústí nad Labem Zoo): 25–32 vs. 41 years. Only a ♀ of *Ceratotherium cottoni* (NMP 93511, from the Dvůr Králové Zoo) was concordant in age estimation with the actually achieved growth: 7–9 years estimated vs. 9 years actually. The retarded dental eruption and wear in captive rhinoceroses was also observed by Goddard (1970) for the black rhinoceros. J. Hrubý (Dvůr Králové Zoo) informed us that the diet of white rhinoceroses in the Dvůr Králové Zoo consists mostly of fresh grass in summer and dry hay in winter. The diet of black rhinoceroses consists predominantly of fresh lucerne and grass in summer and dry lucerne and dry hay in winter ("half to half" in both seasons) and the proportion of lucerne in the diet of rhinoceroses has increased in the Dvůr Králové Zoo during several last decades. The lucerne does not contain abrasive components (silica) in contrast with grass (Clauss & Hatt 2006).

The observed disagreement between expected and actual ages in some captive rhinoceroses is probably associated with much less abrasive diet in captivity (e.g. a smaller proportion of grass). However, here presented data indicate that the diet of captive black rhinoceroses is relatively similar to the natural diet (at least in its abrasiveness), but the diet of captive white rhinoceroses is much less abrasive. Anyway, the zoo diet is presumably much less abrasive than the natural one, as it does not contain dust associated with grass leaves, which is extremely abrasive and certainly present in a much larger degree in savannah habitats than in relatively clean conditions of captivity. Such a difference in the diet abrasiveness probably results in the different values in age estimations.

Diceros subspecies diagnoses

Taxonomy of the black rhinoceros is a highly conflicting topic (e.g. Zukowsky 1964, Groves 1967a, Joubert 1970, Rookmaaker & Groves 1978, George 1987, Guerin 1987, du Toit 1987a, b, Magurire 1987, Ashley et al. 1990, Prins 1990, Groves 1993b, Hillman-Smith & Groves 1994, O'Ryan et al. 1994, Brown & Houlden 2000, Harley et al. 2005, Krummenacher & Zschokke 2007). Colin P. Groves (1967a, 1993b, Rookmaaker & Groves 1978) revised well the taxonomy of *Diceros bicornis*, but his conclusions were not fully accepted by some subsequent authors (see du Toit 1987a, b, Guerin 1987, Ashley et al. 1990, O'Ryan et al. 1994). However, such a controversial question could be answered only with a combination of all morphological evidences (cf. Groves 1967a, Rookmaaker & Groves 1978, Groves 1993b), a large sample size (cf. du Toit 1987b) and taxonomically exhaustive molecular analyses (see Rookmaaker 2005).

Only two subspecies, *D. b. minor* and *D. b. michaeli*, are currently kept in captivity (ISIS) and the Dvůr Králové Zoo has been breeding *D. b. michaeli* regularly for several decades (Holečková 2009). Subspecific affiliation of some examined specimens of the black rhinoceroses was clearly determined due to their association with the Dvůr Králové Zoo breeding group (NMP 25963, 25964, 47655, 48347, some specimens in ZMP and Zoo-Dvur collections) as *D. b. michaeli*. The remaining specimens of unknown origin were tentatively determined according to Rookmaaker & Groves (1978) and Hillman-Smith & Groves (1994) based on examination of the following characters:

(a) The infraorbital foramen, situated over P^3, is often bifid in southern populations, and sometimes in *D. b. brucii* and *D. b. longipes*, but never in the East African populations: the bifid infraorbital foramen is present in NMP 93515 (bilaterally), NMP 93517 (sinistrally, the lower smaller foramen is also divided in two smaller foramina), and ZMP *Diceros* 01. Thus, we can exclude the East African origin of these specimens.

(b) A crista is almost always absent from the molars, but is present on the premolars (especially P^3 and P^4) in *D. b. bicornis*, *D. b. brucii* and *D. b. longipes*, while not in other subspecies: the crista is well expressed in NMP 93516 and ZMP *Diceros* 01.

(c) The crochet on molariform maxillary premolars is often bifid in *D. b. minor* and other eastern and southern subspecies, but simple in *D. b. brucii* and *D. b. longipes*: the bifid crochet is clearly visible in NMP 93515.

(d) The first mandibular premolar is generally absent in the East African (*minor*, *michaeli*, *ladoensis*) and the Cape subspecies, while usually retained in *D. b. brucii* and *D. b. longipes*; 60% occurrence was observed in the southernmost population of *D. b. minor* (Hluhluwe): the first premolar or its traces are present in NMP 93515 (dextrally, as rudimental or broken), NMP 93516 (sinistrally), NMP 25963 (two alveoli – both premolars were shed), and NMP 93517 (bilaterally).

Of the above-mentioned specimens, only NMP 25963, NMP 93516, NMP 93517 come from adult individuals (based on their complete dental eruption).

In summary, we tend to exclude the East African origin of the following specimens: NMP 93515, 93517, and ZMP *Diceros* 01 based on the bifid infraorbital foramen situated over P^3. The specimen 93517 could be tentatively regarded as *D. b. brucii* or *D. b. longipes*, for the combined presence of the bifid infraorbital foramen, both first mandibular premolar and simple crochet. The specimen NMP 93516 could be considered as *D. b. brucii* or *D. b. longipes* for

the combined presence of the crista, simple crochet and mandibular first premolar. The same identification could be tentatively considered for ZMP *Diceros* 01 due to the combined presence of the bifid infraorbital foramen, crista and simple crochet. However, all these determinations remain tentative for the lack of any associated information about their geographic origin.

Rookmaaker & Groves (1978) detected many unique characters for *D. b. bicornis* – no specimen here mentioned possesses typical dental and skull characters of this extinct form.

We can only note that a specimen of such affiliation could be present in the NMP collection; a famous traveller and collector Emil Holub collected zoological and ethnological material in southern Africa in 1872–1879 and 1883–1887 (see below). Southern Sudan and East Africa belonged to attractive safari destinations for noblemen and trophy hunters from Europe and North America in the first half of the 20th century (cf. Němec 1930, Machulka 1958, Herne 2001). Considering that, *D. b. brucii* identifications in some specimens (NMP 10657, 93516, 93517, ZMP *Diceros* 01+02) seem to be more probable than *D. b. longipes* ones.

Groves (1971) detected interpopulation variation in the horn morphology in *Diceros bicornis*. The stem is more slender in the Kenyan specimens, in which the anteroposterior diameter of the stem reaches 50–61% of the base in adults, while 71–92% in other areas. Based on this character, we could expect Kenyan origin in the following specimens: NMP 54481, 57254, 57399, 57438, 57825, 57829–57831, 57833, 57835, 57839, but not in NMP 57261, 57836, and 57841.

Ceratotherium cottoni in the National Museum Prague

The specimens of *Ceratotherium cottoni* in the NMP come from the captive group kept in the Dvůr Králové Zoo. Altogether 22 individuals of the northern white rhinoceros were aggregated in two groups in the San Diego Zoo and in the Dvůr Králové Zoo (Váhala et al. 1993, Holečková 2009). Only the latter zoo was successful in breeding of this species: four ♀♀ (1977 Nasi, 1983 Nabire, 1989 Najin, 2000 Fatu) and one ♂ (1980 Suni) were born there (additionally, a ♀ was aborted in 1991). The Dvůr Králové group originated from wild-captured individuals (Sudan, 1970s) and individuals transferred from other zoos (Prescot, Chartum) (Váhala et al. 1993; Holečková 2009). This captive group was broadly studied from the morphological, karyological, genetical, reproduction and ethological points of view (Hillman-Smith 1986, Merenlender et al. 1989, Stratil et al. 1990, Mikulica 1991, George et al. 1993, Váhala et al. 1993, Houck et al. 1994, Schwanzenberger et al. 1998, Kuneš & Bičík 2002, Hermes et al. 2005, 2006, Cinková 2006, 2009, Policht et al. 2008, Holečková 2009, Groves et al. 2010, etc.). Unfortunately, this last breeding group has not produced any calf since 2000 and all attempts to produce young *via* artificial insemination were unsuccessful. Two ♂♂ (Sudan, Suni) and two ♀♀ (Najin, Fatu) were transfered to the Ol Pejeta Reserve (Kenya) in December 2009 for stimulation of a natural behaviour and 'revival' of their reproduction. Two ♀♀ (old Nesari and relatively young Nabire, but with a uterus tumor) were not transferred to Kenya and they currently exhibit some interactions with one ♂ (Natal) of *Ceratotherium simum* in the Dvůr Králové Zoo.

As noted above, the taxonomy of African rhinoceroses is highly conflicting, especially in the black rhinoceros, but also in the white rhinoceros. Two subspecies of the white rhinoceros are recognised – *Ceratotherium simum cottoni* and *C. s. simum* (for details see e.g. Emslie & Brooks 1999). Some authors supposed that these forms were separated on the basis of their geographical isolation, but Groves (1975, 1992) first exhaustively specified differences between them and was followed by Guérin (1987) and George et al. (1993). On the contrary, some authors did not accept the separation of two subspecies in the white rhinoceros (Appelman 1958, du Toit 1987b, Merenlender et al. 1989). Despite the former scepticism, recent reassessment of the

two forms elevated them to the species level under the Phylogenetic Species Concept based on marked differences in their morphology, nuclear and mitochondrial DNA (Groves et al. 2010).

The recent recognition of the northern form as a distinct species has profound implications for its conservation. The southern form has been recovered from ca. 20–50 remaining individuals in 1900 to more than 12,000 animals in the present days (Emslie & Brooks 2002, Rookmaaker 2002). The northern white rhinoceros ranks among the most endangered mammals of the world, teetering on the brink of extinction (e.g. Schomber 1966, Hillman-Smith 1990, 2006, Martin & Hillman-Smith 1999, Hillman-Smith et al. 2003). Despite a population increase in the Garamba National Park (DRC) during the last decades (from 15 rhinoceroses in 1984 to 34 in 2002), all these rhinoceroses were killed during several last years in the Garamba (Hillman-Smith 2006, Püttger-Conradt 2006). The current situation of the population is hopeless, contrasting dramatically with that in 1986 (see Hillman-Smith et al. 1986a). The scientific significance of the *Ceratotherium cottoni* specimens assembled in the NMP is therefore enormous and their documentation value is extremely high.

Tapirs and rhinoceroses in other collections

Tapirs and rhinoceroses certainly fascinate people (cf. Brentjes 1978, Rookmaaker 1982, 2007, Rookmaaker et al. 1998). Many private collections were donated to or confiscated for the NMP. Many natural history collections were concentrated in the National Museum after the WWII, e.g. the collections by Riedl, Beaufort, Auersperg-Trauttmannssorf, Thurn-taxis, Hanau-Schaumburg, Böhm, etc. (Štepánek 1975: 122). The uncontrolled confiscations caused the loss of evidence or possibility to associate the specimens with original data in many cases.

Despite these facts, additional material of ceratomorphs may be present in other museums or similar collections, like schools or cabinets of curiosities in castles. Certain material can be also present in private collections. We would be indebted for any information on additional ceratomorph specimens in the Czech Republic. Of course, specimens with known geograpical origin and age (captive individuals) are the most valuable.

Here, we briefly mention all us known institutions with the material of ceratomorphs:

(1) J. Hotový (Museum of Eastern Bohemia, Hradec Králové) informed us about a tapir skull in the collection of the Department of Biology, Pedagogical Faculty, University of Hradec Králové: poorly preserved skull with mandible; left zygomatic arch and the distal part of the left palate are incomplete, coronoid and condylar processes on the left mandible broken, dorsal edge of the right mandible partly abraded, horizontal cracks in lower incisors and canines; dentition well preserved. Upper and lower dentitions: all teeth fully erupted; both M^3 and M_3 show no wear. **O**: absent, "E" written on the skull. **N**: *Tapirus terrestris*. Skull sutures closed in the dorsal view. Age estimation based on teeth eruption and wear (Maffei 2003): 6 years. Nasal septum well preserved.

(2) Moravian Museum (Department of Zoology, Brno): (a) complete skeleton, *Tapirus terrestris*, inv. n. 1467. (b) mounted head, *Diceros bicornis*, inv. n. 180, leg. Chorinsky, B. O. A. – Kabiti Plains (= Britisch-Ostafrika [= British East Africa, present-days Uganda and Kenya]), 1911. (c) mounted head, *Diceros bicornis*, inv. n. 181, leg. Salm R., Ithanga Hills (near Nairobi, Kenya), 20 December 1910. (d) mounted head, *Diceros bicornis*, inv. n. 182, leg. Chorinsky, Ruwana (near Masai Mara, Tanzania), 1911 (Jiří Chalupa, in litt.). According to geographical origin, we could identify these specimens tentatively as: (b): *D. b. ladoensis*, (c) *D. b. michaeli*, (d) *D. b. minor* (Groves 1967a, Hillman-Smith & Groves 1994).

(3) Municipal Museum and Library (Čáslav): an isolated partly damaged tooth. Greatest length 58 mm, greatest breadth 47 mm, greatest crown height 42 mm, root length 37 mm. **O**: "*Rhinoceros*, 164 g". **N**: Uncertain. We originally identified it as *Diceros bicornis*, but we were not able to specify the tooth position in the upper toothrow. C. P. Groves (in litt.) suggested: "Isolated teeth are always going to be difficult to identify, but I think as follows: I would say *Diceros bicornis*, because of the shape of the ectoloph (somewhat sinuous, but not as much as usual in *R. sondaicus* or *D. sumatrensis*), also the 'protocone strangulation' seems to rule out *R. sondaicus*. As for the position in the toothrow, this is very difficult. In particular, it is difficult to distinguish P4, M1 and M2, so I would hazard a guess that specimen is M1/2." The Čáslav collection was accumulated by Josef Kaunický (1819–1908), a joiner and piano tuner and also an entusiastic natural history collector, who spent 25 years in London (for more information see Robovský et al. 2009).

(4) The *Ceratotherium simum* × *C. cottoni* crossbred specimen (♀ Nasi, 1977–2007, Dvůr Králové Zoo) is present in three private collections. The skull is in a private collection of Přemysl Rabas, the complete postcranial skeleton and mounted head skin with horns in the ZMP collection (see above) and small skin sections, tongue and hairs are deposited in the collection of the first author at the Department of Zoology, Faculty of Science, University of South Bohemia (České Budějovice) for comparative purposes.

(5) Dr. Emil Holub Memorial – African Museum in Holice: Jitka Koudelková, a curator from this museum, provided us with the list of rhinoceros specimens (for their photos see an open-access digital archive –http://muzeum.kd.holice.cz/Default.aspx?categoryId=28): (a) mounted head, *Diceros bicornis* 7008/1953, a.n. 8/1967. (b) horn, *Diceros bicornis* 7008/1953, a.n. 9/1967. (c) horn, *Diceros bicornis* 7008/1953, a.n. 10/1967. (d) horn, *Diceros bicornis*, a.n. 4/1964. (e) three skin sections, a.n. 31–33/1966; the sections were donated by E. Holub to schools (Brodek near Přerov and Třebíč) and were obtained by the Museum later. Specimens (a–c) were obtained from the National Museum, they were exhibited first as a long-time loan (1967), later (2001) were transferred to the Museum property. Some of the specimens could have an association with the activities of E. Holub (1847–1902), who visited southern Africa in 1872–1879 and 1885–1887 (Želízko 1902). He donated rich and various (ethnographical, zoological etc.) collections to important European museums, but also to local collections, such as schools (Želízko 1931, Štepánek 1975). His collection originates from southern Africa, from the region between Port Elisabeth and Cape Town (South Africa) in the south to the Bulala Hills, W of Lusaka (Zambia) in the north (Želízko 1902). Since the extinction of the Cape rhinoceros, *D. b. bicornis*, is estimated at around 1850 (Rookmaaker & Groves 1978), the Holub's specimens could be identified as *D. b. minor* or *D. b. chobiensis*. However, there is not a direct link between the Holub collection and the Holice specimens.

(6) Telč State Castle: Hanák (2005) created a catalogue of the African collection (exhibited in the 'African Hall') stored in the Telč Castle that consists of 161 specimens of 50 species (1 reptile, 1 bird and 48 species of African and Arabian mammals). Four specimens of *Diceros bicornis* are noted without any additional data on the preparation or more accurate geographic origin. However, according to the photographic evidence (Hanák 2005; www.zamek-telc.eu) we can specify these specimens (trophies) as two pairs of rhinoceros horns (on wood tables) and two mounted head skins with pairs of horns. The collection was established by Count Karl Podstatzky-Lichtenstein (1874–1946) from trophies obtained during his six hunting expeditions to Africa and Arabia (1902–1914).

(7) Bítov State Castle: Hanák et al. (1999) created a catalogue of some vertebrates from the Bítov Castle, in which they mentioned one mounted head of *Diceros bicornis* (No. 1618). However, the castle warden Jan Binder (in litt.) informed us that only a rhinoceros horn without any associated data on its origin is present in the zoological exhibition. The Bítov Castle collection is rich in specimens, Hanák et al. (1999) listed 374 vertebrate preparations of 251 species. Most of the collection was acquired by Baron Georg Haas von Haselfels (1876–1945) from his private zoo and from specialised shops (e.g. Václav Frič Company in Prague), but the African trophies were probably acquired by former owners of this castle – Counts Otokar & Vladimir Daun during their journey around the world (Hanák et al. 1999, Binder, in litt.).

(8) Strahov Monastery, Royal Canonry of Premonstratensians at Strahov (Prague): a rhinoceros horn (first one from a pair) is exhibited in the Cabinet of Curiosities. Based on the characters given by Groves (1971) it certainly belongs to Dicerotinae; the anteroposterior diameter of the horn base does not discriminate between *Ceratotherium* and *Diceros*, but it meets rather the variation scale typical for *Diceros*. Horn measurements: straight length 880 mm, anteroposterior width of the base 160 mm, transverse width of the base 125 mm, anteroposterior of the stem 85 mm, transverse breadth of the stem 70 mm, height of the basal portion (anterior side, left side, posterior side, right side) 210, 215, 210, 220 mm. This collection of interesting natural history objects (e.g. shells, butterflies, turtles, elk antler, mammoth and narwhal tusk, cetacean penes) has a composite character. It arose over a long time from the end of the 18th century.

(9) Vrbas museum (Ždánice): a rhinoceros horn (first one from a pair) on the wood base. Based on the characters given by Groves (1971) it certainly belongs to *Diceros*. Horn measurements (kindly taken by Monika Jandorová): straigth horn length 365 mm, outer horn length on the anterior 445 mm, outer horn length on the posterior edge 405 mm, anteroposterior breadth of the basal portion 120 mm, transverse breadth of the basal portion 112 mm. The museum is a regional institution with diverse collections, including also some zoological and palaeontological specimens (e.g. remains of a mammoth or cave bear).

(10) Museum of Eastern Moravia (Zlín): mounted head of *Diceros bicornis* with two horns, leg. Chorinski, Tana River, 1911; collection number ZM 4190737/01, 66/84. The specimen is associated with a zoological collection of Count Nikolaus Chorinský z Ledské (1872–1939) from Veselí nad Moravou, later it was probably obtained by the Baťa Company, later it became a part of the collection in the Museum of Eastern Moravia in Zlín. The collection of Count Chorinski consists of several additional specimens of African ungulates (Dušan Trávníček, in litt.). We identified the rhinoceros specimen as *D. b. michaeli*, based on geographical origin (Groves 1967a, Hillman-Smith & Groves 1994).

(11) Buchlov State Castle (Buchlov): five rhinoceros horns are exhibited in a hall together with some other zoological specimens/curiosities (e.g. two narwhal and elephant tusks, *Equus grevyi* skin, several exotic birds, etc.). These horns perhaps represent several rhinoceros species (African and Asian, based on short examination). However, the specimens remain inaccessible for proper examination in spite of several attempts.

For completeness, it should be noted that many fossil ceratomorphs are present in several collections. Many specimens are deposited in the Department of Paleontology, National Museum, Prague. Most of the material comes from the first half of the 20th century (partly mentioned e.g. by Kafka 1913), a minor part was excavated in the last decades (B. Ekrt, pers. comm.).

Fossil ceratomorphs were collected mainly by two leading personalities of the Czech paleontological science, Oldřich Fejfar (his collections are now concentrated in the NMP) and Rudolf Musil (collections gathered by him and his colleagues are deposited in the Moravian Museum (Anthropos Pavilion) and Archeological Institute of the Academy of Science, both in Brno). Considering our survey across several institutions, we would like to note that one fragmented skull and relatively numerous postcranical remains of *Coelodonta antiquitatis* are deposited in the Chrudim Regional Museum (S. Vylíčilová, pers. comm.). This museum has a relatively rich collection of nature history items (some 6400 specimens).

SOUHRN

Katalog tapírů a nosorožců se snaží zmínit veškerý materiál těchto svérázných savců uložený ve sbírkových institucích České republiky a to na základě publikovaných katalogů, dotazníkových akcí a revizí dílčích sbírek. Přes snahu prověřit veškerý material ceratomorf v ČR byly nakonec s ohledem k časovým a logistickým možnostem detaillně revidovány jen největší a/nebo nejvýznamnější sbírky. Katalog zmiňuje 190 sbírkových položek dvou druhů tapírů (tapír čabrakový, tapír jihoamerický), pěti druhů nosorožců (nosorožec tuponosý, nosorožec Cottonův, nosorožec dvourohý, nosorožec sumatránský a nosorožec indický) a jednoho hybridního jedince nosorožce tuponosého a nosorožce Cottonova, který byl jediný svého druhu. Za nejvýznamější sbírky z hlediska zastoupení ceratomorf lze považovat sbírku Národního muzea v Praze, Lovecko-lesnického muzea v Úsově a Zoologického muzea v Protivíně. Značná část materiálu pochází z přírody, v případě tapírů ale v naprosté většině chybějí údaje o jeho geografickém původu; v případě nosorožců jsou sice tyto údaje vesměs k dispozici, ovšem jedná se většinou o trofejně upravené nosorožčí rohy, nikoliv o další mnohdy hodnotnější sbírkový materiál (lebky, kostry, kůže, měkké tkáně). Přestože řada sbírkových jedinců pochází ze zoologických zahrad a má tak omezené využití pro taxonomické účely, je výborně využitelná pro kalibraci stanovení věku na základě prořezávání a obrusu dentice a také pro obecnější vysledování vlivu lidské péče na somatické parametry chovaných zvířat. Za nejhodnotnější materiál lze považovat čtyři nosorožce Cottonovi a mezidruhového kříženec nosorožců rodu *Ceratotherium* pocházející ze zoologické zahrady ve Dvoře Králové nad Labem.

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