THE FIFTH DIGIT OF APROTODON (RHINOCEROTIDAE) FROM THE MIocene KALKAMAN LOCALITY, KAZAKSTAN

BOLAT BAYSHASHOV1 and SPENCER G. LUCAS2

1Institute of Zoology MES PK, Almaty, Kazakhstan -email: bolat.bayshashov@mail.ru;
2New Mexico Museum of Natural History and Science, 1801 Mountain Road NW, Albuquerque, NM 87104

Abstract—We document the rare preservation of digit V of the manus in a fossil rhinoceros, Aprotodon from the Miocene Kalkaman locality, eastern Kazakhstan. The digit V of Aprotodon described here is small and narrow—clearly not a weight-bearing part of the manus. This is the first record of a manus digit V in a teleoceratine rhinoceros. We predict that this is the morphology of any manus digit V of a fossil rhinoceros.

INTRODUCTION

Rhinoceroses have a functionally tridactyl manus in which the largest, central digit is digit III, flanked by somewhat smaller digits II and IV (e.g., Peterson, 1920; Scott, 1941; Klaitz, 1972; Prothero, 2005). However, in a few specimens digit V is preserved as a rudimentary structure, and we describe such a specimen here. Aprotodon is a well known mid-Cenozoic rhinoceros from Asia (e.g., Forster Cooper, 1915; Borisyak, 1944). However, due to their rarity, limb bones of Aprotodon are poorly understood. The rhinoceros postcranial material discovered at the Miocene Kalkaman locality in eastern Kazakhstan (Fig. 1), some of which is described here, is very similar to that of Aprotodon ayakozensis. Here, we describe a rare case of preservation and discovery of the manus digit V of Aprotodon from the Kalkaman locality.

PROVENANCE

The Kalkaman locality is on the northwestern shore of the salt lake Small Kalkamantuz, north of the village Soltvetka in the Pavlodar region of eastern Kazakhstan (N52°04.319, E076°31.126) (Fig. 1). Fossil remains of vertebrates were discovered there in the first half of the last century (Borisyak and Beliayeva, 1948). Further study revealed a large number of vertebrates of middle-late Miocene age (e.g., Bazhanov, 1955; Lychev, 1963) in deposits attributed to the Aral Formation (Lavrov, 1959). According to Lychev (1963), the bones were float washed out of an upper layer no longer present at the locality. Later, the deposits containing the Kalkaman fauna were assigned to the Ermak Formation (Biryukov et al., 1968), and then to the Kalkaman Formation (Zykin and Zazhigin, 2008). Lists of the fauna of the Kalkaman locality were given by Lychev (1963) and Tleuberdina et al. (1993). As the result of research carried out by one of us (BB) at Kalkaman in 1984, in situ material was discovered of a large number of well-preserved fossils, mainly of the rhinoceros Aceratherium gobiense Beliayeva, 1960 (Bayshashov, 1988, 1993). Among the earlier described material from Kalkaman, Lychev (1963) referred a single tooth to the rhinoceros Aprotodon (?) sp. The structure of the tooth is very similar to the teeth of A. ayakozensis Bayshashov, 2001, found at the early Miocene Ayakoz site (Bayshashov, 2001). In 2009, during further fieldwork at Kalkaman, BB found part of the distal forclimb of a rhinoceros associated with other postcrania referable to Aprotodon (Figs. 2-3). Particularly interesting is the presence of a rudiment of the fifth finger (digit V of the manus). Although this is 2-3 times smaller than the functional fingers, it is a fully-developed bone (Fig. 3).

DESCRIPTION

The material described here (Figs. 2-3) is in the collection of the Institute of Zoology, Almaty, Kazakhstan: № 19/61-09 mtc-III, № 19/62-09 mtc IV, № 19/64-09 mtc-V, and phalanges of digit III (№ 19/4-09 Ph-I, № 19/5-09 Ph-II, № 19/6-09 Ph-III), phalanges of digit IV (№ 19/7-09 Ph-I, № 19/8-09 Ph-II, № 19/9-09 Ph-III), phalanges of digit V (№ 19/12-09 Ph-I, № 19/13-09 Ph-II, № 19/14-09 Ph-III).

FIGURE 1. The Kalkaman locality in eastern Kazakhstan.

FIGURE 2. Phalanges of manus digit V of Aprotodon. A, is the proximal phalanx; B, the second phalanx; and C, the distal (ungual) phalanx. Each phalanx in two views, dorsal (left) and ventral (right).
very similar to that of \textit{Trigonias} in being small and narrow—clearly not a weight-bearing part of the manus. This is the first record of a manus digit V in a teleoceratine rhinoceros. It is fair to predict that this is the morphology of any manus digit V of a fossil rhinoceros.

\section*{ACKNOWLEDGMENTS}

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\section*{REFERENCES}

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Bayshashov B.U., 2001, New data on the location of the ancient ungulates Ayakoz and biostratigraphy: Geology of Kazakhstan, v. 5-6, p. 140-147.


\section*{DISCUSSION}

The discovery of digit V in fossil rhinoceroses is very rare for three reasons: (1) in the majority of rhinoceroses this bone is absent; (2) fragile and small bones like those of digit V quickly break down after the death of the animal or are eaten by predators/scavengers and thus are not preserved; and (3) individual phalanges of digit V may be found, but are easily mistaken for the bones of another, smaller mammal. In contrast, metacarpal V is common and well known in various fossil rhinoceroses, though it is often reduced in size relative to the other metacarpals (Wood, 1964; Prothero, 2005, fig. 5.28).

Other than the \textit{Aprotodon} manus digit V described here, information on this digit in fossil rhinoceroses is very limited in the published literature. Another example of digit V preservation in a fossil rhinoceros is a right manus of \textit{Trigonias osborni} from the late Eocene (Chadronian) of North America illustrated by Scott (1941, pl. 83, fig. 7; reproduced in Prothero, 2005, fig. 5.18B). Scott (1941, p. 782) provided no description of this digit other than to remark that “the fifth digit, though complete in all its parts, is so reduced as to be little more than a vestige without function.” The digit V of \textit{Aprotodon} described here is very similar to that of \textit{Trigonias} in being small and narrow—clearly not a weight-bearing part of the manus. This is the first record of a manus digit V in a teleoceratine rhinoceros. It is fair to predict that this is the morphology of any manus digit V of a fossil rhinoceros.

\section*{FIGURE 3. Phalanges of manus digits III and IV of \textit{Aprotodon}. A, is the row of proximal phalanges; B, the second phalanges; and C, the distal (ungual) phalanges. Each phalanx in two views, dorsal (left) and ventral (right).}

Measurements of these bones are in Appendix.

The phalanges of digits III and IV (Fig. 2) are short and broad and well resemble those of many other rhinoceroses (e. g., Prothero, 2005).

The digit V phalanges (Fig. 3), however, are much smaller and relatively longer and narrower (Appendix). The first (proximal) phalanx of digit V is nearly square in anterior view, with a large, concave proximal facet and a narrower, convex, distal articular facet that is a trochlea. The second phalanx is about the same size as the first and more nearly trapezoidal in anterior view. However, like the proximal phalanx, it has a broad and concave proximal articular facet and a distal articular facet that is narrower and trochlear in shape. The third (distal or ungual) phalanx is much smaller than the other two phalanges and more equant, in that the proximal and distal articular surfaces are nearly the same width. The shaft of the phalanx is constricted (waisted) between them. Unlike the ungual phalanges of digits III and IV, the distal end is not broadened and rugose, probably because digit V bore little or no weight.

Appendix

Measurements and indexes of phalanges of *Aprotodon*.

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Digit III</th>
<th>Digit IV</th>
<th>Digit V</th>
</tr>
</thead>
<tbody>
<tr>
<td>(in mm and indexes in %)</td>
<td>Ph-I</td>
<td>Ph-II</td>
<td>Ph-III</td>
</tr>
<tr>
<td>1 Maximum length</td>
<td>29</td>
<td>23</td>
<td>33</td>
</tr>
<tr>
<td>2 Proximal width</td>
<td>48</td>
<td>46</td>
<td>69</td>
</tr>
<tr>
<td>3 Diameter</td>
<td>33</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>4 Width of upper articular surface</td>
<td>42</td>
<td>37</td>
<td>41</td>
</tr>
<tr>
<td>5 Diameter of upper articular surface</td>
<td>29</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>6 Distal width</td>
<td>37</td>
<td>41</td>
<td>76</td>
</tr>
<tr>
<td>Index 2:1</td>
<td>165.5</td>
<td>200</td>
<td>209</td>
</tr>
<tr>
<td>Index 3:2</td>
<td>68.7</td>
<td>54.3</td>
<td>28.9</td>
</tr>
<tr>
<td>Index 6:2</td>
<td>77.0</td>
<td>89.1</td>
<td>110.1</td>
</tr>
</tbody>
</table>

