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## BIRD TRACKS IN THE LOWER MIOCENE SHORE OF RHINOLAND AND CROCODILIA AT IPOLYTARNÓC, HUNGARY

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### ABSTRACT

The Lower Miocene paleontological locality-complex (Ipolytarnóc, N Hungary) well known since the middle of 19th Century. The gigantic petrified tree trunk, the rich shark-teeth bearing intertidal sandstone, the leaf contains terrestrial sandstone and rhyolite tuff, and of course the great number animal tracks are in a relative small area. The terrestrial animal footprints four bird, four carnivore, two artiodactyle and the perissodactyle rhinoceros ichnotaxa distinguished between the years of 1900 and 2015. During the last three years the authors discovered thousands of specimens in several new ichnotaxa. Present paper likes to summarize the new records of bird tracks from Ipolytarnóc, some comments to the evolution of footprints, the paleohabitat reconstruction, and the phenomena of Early Miocene bird track concentrations in the Central and Eastern Paratehys areas.

### INTRODUCTION

The Lower Miocene (20-17 Ma) sandstone contains bird tracks (footprints) discovered first in 1900 and later several times opened new parts of the locality complex. The history and the four new bird ichnotaxa were summarized by Kordos (1985). Since 2015 the authors have identified several thousands of footprints and body impressions, including new amphibian, reptile, bird and mammal ichnotaxa. On the base of the re-interpretation the paleohabitat distinguished the interfingering terrestrial (Rhinoland) and intertidal pool (Crocodilia) landscape situations.

### METHODS

More than hundred years ago scientists mapped, made casts, photographs and measurements of the sandstone surfaces. Since 2015 the present authors studied the never before seen hidden shallow tracks in detail. They made several thousands of high resolution digital pictures and later separated the very different sized footprints and tracks and the thin sandstone layers on the computer. Using electronic light taking photos proved very difficult, therefore an expensive portable laser surface scanner method was successful tested.

### RESULTS

The present number of studied bird footprint items on the cca 600 m<sup>2</sup> original and cast surfaces contains about 1.600 specimens of 15 ichnotaxa.

### DISCUSSION

Short description of bird foot morphological types from Ipolytarnóc. Four bird footprint types have been partly revised, the new ones very probably will be new ichnotaxa in the future. (1-3) large, medium and small size ancient shape tridactyl foots (partim *Ornithotarnocia lambrechtii*, *Aviadactyla media*, *Aviadactyla* (= *Passeripedia*) *ipolyensis* (Kordos, 1985).

(4) Small size almost symmetrical tridactyl foot; the digit III is strait and long (2 cm), the digits II and IV are shorter (1,5 cm); the middle digit impression contains ring-like scutum squamas;

(5) Medium size (length 2,0-2,8 cm) tridactyle, asymmetric digit impressions, perhaps webbed;

- (6) Small size (length 2 cm) tridactyl, narrow and long digits with curved claws and short hallux impression; the toes are closer to each others;
- (7) *Tetraornithopedia tasnadii*, large size morphological similar foot as *Ornithotarnocia*, but tetradactyle (digit I present);
- (8) Larger size (length 4,8-5 cm) zygodactyl, elongated “X” shape, slightly curved, clawed footprints; in the middle small rounded hallux is present. The backward positioned digits contain a third, shorter pseudo-digit (trace of the tarsometatarsus), like frequently in the roadrunner;
- (9) Small size (length 2 cm) zygodactyls footprint; the morphology same as the larger size one;
- (10) Medium size (length and with 4-5 cm) webbed track. Between the symmetrical and strait digits have two webs, ending at the tips (Mészáros & Kordos, 2016);
- (11) Small size (total length 5 cm), forward have three asymmetric, 3 cm long digits ending in claws. The webs between digits, distal parts have concave margins. Backward has one short and corn shape impression;
- (12) Very small (length 1,5 cm), between the asymmetric digits are webs; proximally has one long oblique oriented digit I. Similar morphology has the braun pelican;
- (13) Medium size (digit III 5 cm, digit II 2,8 cm long with deep sharp margins; the digit IV is very shallow), *Tetraornithopedia*-like but asymmetric, slightly curved imprint;
- (14) Medium size (digit III length is 5 cm). The curved, asymmetric digits terminating in claws; backward in the midline has a long and narrow impression; the digits have ring-like scutum prints. The type is similar to grouse;
- (15) Among the bird tracks of *Ipolytarnóc* a larger size (length 8-9 cm) predatory (grasping) bird have clawlike feet (talons); to the long proximal impression a short digit I (?) is connecting.

*Notes on the evolution of bird footprints.*

The tridactyle tracks are indicating a multifactoral convergence from the Cretaceous *Koreanaornis* and similar forms thorough the Cenozoic (Diaz-Martinez et al., 2015). The tetradactyle foots from *Ipolytarnóc* and other localities based on the ancient steam characters with digit I and web development directions. The first occurrence of zygodactyl footprints are from the Early Cretaceous (Lockley et al, 2007), and common during the Cenozoic. The oldest web-footed birds found from the Lower Cretaceous of South Korea and China (Lim et al, 2000). The cranial margin of the first webs appeared in the anterior base of the digits, and later in different way developed to the tip of digits. The true webs at *Ipolytarnóc* birds are covering the whole interdigital areas. The foot types during the Early Miocene in the later elevated Carpathian Basin and its foothills showing a wide variety developed from the stem groups.

*Paleohabitat reconstruction at Ipolytarnóc.*

Between the first discovery of footprint bearing surfaces (1900) and 2015 the habitat described in a very simply way: terrestrial animals lived close to a stream or see side under subtropical climate. Recently discovering the thin layers of sandstone with great diversity of interfluvial vertebrate tracks, another model was constructed where the terrestrial bank (after the rhino tracks) named as *Rhinoland* intercalated with the wet environment (*Crocodilia*). The bird tracks describe the characteristics of the lacustrine – fluvial wetland situation. The footprints were mostly found on small sandy hills.

*The bird track concentrations are mostly from the Early Miocene Central Paratethys and its neighbouring.*

During the Early Miocene, especially the present Carpathian foreland, in Romania and Ukraina several track locality described (Panin & Avram, 1962; Vialov, 1966). They are contains

several types tracks of wetland birds and different mammals. According to the development of the Central and Eastern Paratethys in Middle Europe (Hámor, 2001) before the elevation of the Carpathian arch in the depressions molasse accumulated by fluvatile-lacustrine-marine transportations. This situation caused similar faunal structure by different species.

## CONCLUSION

Since 1915 at the Lower Miocene locality Ipolytarnóc (N Hungary) a great amount of bird tacks were distinguished. They belong 15 ichnospecies 4 are described before, the rests new from systematic point of view. Among the different morphotypes the wet bearing specimens are dominating. The bird tracks concentrating inthe terrestrial and on the sandy hills of intertidal ponds habitats. In a wider geographical view along the Carpathian foots in the Middle and Eastern Paratethys caused similar faunal content with different taxa.



Fig. 1 “Crocodilia and “Rhinoland”  
at Ipolytarnóc (Hall I)



Fig. 2 Bird tracks at Ipolytarnóc  
(Hall II)

Photo: I. Mészáros

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