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First fossil record of leopard-like felid (*Panthera* cf. *pardus*) from alluvial deposits of the Po River in northern Italy

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ABSTRACT

A slender right felid tibia has been found in river deposits of the Po River in the territory of Cremona (Northern Italy). The fossil, found in allochthonous position within an alluvial bar, shows an overall slenderness and subtlety, different shape of the shaft from lateral view, or less pronounced medial malleolus, corresponding in morphology and dimensions rather with tibiae of modern leopards than with shinbones of larger pantherines or feline cats. The bone is, however, faintly rounded (surface erosion of the edges in particular on the head of the tibia), indicating a limited transport (rafting). Based on that, it is determined as *Panthera* cf. *pardus* only. The whole mammalian fossil record from the site consists predominantly of large herbivores (*Elephas* (*Palaeoloxodon*) *antiquus*, "*Dihoplus*" (*Stephanorhinus*) *kirchbergensis*, *Bison priscus*, *Megaloceros giganteus*, *Mammuthus primigenius*, *Alces alces*, *Cervus elaphus*), whereas carnivores (*Ursus arctos*, *Crocuta crocuta* ssp., *Canis lupus*, *Vulpes vulpes*) are very rare and composed only by a few specimens. The species composition indicates probably a mixing of different faunal assemblages from warm (interglacial) and cold (glacial) periods of the Late Pleistocene.

1. Introduction

The recent geographical distribution of the leopard (*Panthera pardus*) stretches from Africa to East Asia. During the Pleistocene, however, this felid inhabited Europe, but never penetrated to North America (Turner and Antón, 1997). The oldest European fossil record of the leopard is mentioned from French site of Le Vallonnet (Vallonnet Cave) dated to the period 1.0–0.9 Ma ago (Moulle et al., 2005; Madurell-Malapeira et al., 2014), although Hemmer (2001) attributed all Early Pleistocene leopard fossils to *Puma pardoides*. Middle Pleistocene remains of leopards are known from the Iberian Peninsula (Sanchis et al., 2015) through Western and Central Europe to the south of the Old Continent (Sabol, 2008). Even at the beginning of the Last Glacial, the species was extended here from the south to Poland. With the intense climate changes, however, leopards gradually retreated southward and had occurred only in isolated areas at the end of the Pleistocene Period (Musil, 1986). They probably survived for longer only in the Iberian Peninsula (Late Glacial – Early Holocene; Sauquó and Cuenca-Bescós, 2013; Sanchis et al., 2015) and in Eastern Europe even until historical times (Spassov and Raychev, 1997).

A relatively rich fossil record of leopards comes from the Apennine Peninsula, whence minimally 32 Pleistocene sites are so far referred (Maviglia, 1952; Diedrich, 2013; Sauquó and Cuenca-Bescòs, 2013; Pacher and Rabeder, 2016). The postcranial bones are, however, much more rare in the fossil record than finds of cranial skeleton and teeth. In summer 2014, however, a new well-preserved leopard-like tibia was discovered on the alluvial bar of the Po River right bank in Cremona (Northern Italy), close to the harbour entrance (Fig. 1). The area, which is well-known for its numerous palaeontological Quaternary record, composes of a crescent-shaped meander bar (about 1 km), located downstream the big meander of Isola Serafini, in which converges the Adda River.

Ever since the 1970s large fossils and palaeontological evidence have been discovered in this area which do not show signs of having been transported by the river probably due to the intense erosion process generated by the natural morphology of the river, the hydrodynamic context generated by the confluence with the Adda river, the current generated by the functioning of the Isola

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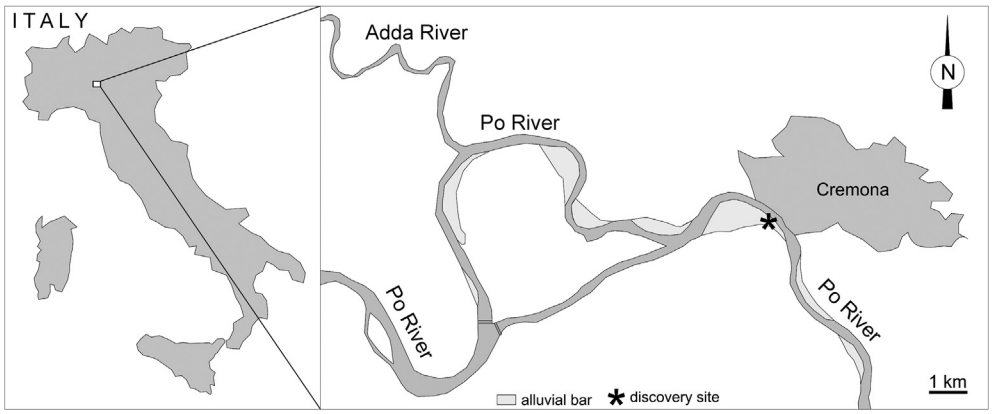

Fig. 1. Location of the site near Cremona in northern Italy, where leopard-like tibia was found.

Table 1
Panthera cf. *pardus*, measurements of the right tibia from alluvial deposits of the Po River near Cremona in northern Italy.

Panthera cf. *pardus* (tibia dext.), Po River (Italy)	
(1) Maximum length	239.4 mm
(2) Length of the tibial crest	71.5 mm
(3) Maximum anteroposterior diameter of the proximal epiphysis	45.5 mm
(4) Maximum transverse diameter of the proximal epiphysis	42.0 mm
(5) Breadth of the poplitea cavity	10.1 mm
(6) Minimum anteroposterior diameter of the diaphysis	23.3 mm
(7) Minimum transverse diameter of the diaphysis	18.7 mm
(8) Maximum anteroposterior diameter of the distal epiphysis	21.9 mm
(9) Maximum transverse diameter of the distal epiphysis	29.0 mm
(10) Anteroposterior diameter of the distal articular surface	14.5 mm
(11) Transverse diameter of the distal articular surface	21.9 mm

Serafini hydroelectric power station and the possible presence of surface Pleistocene fossiliferous strata.

The found leopard-like fossil is the first record of large felid from the Po River. It is a part of the mammalian assemblage, consisting predominantly of large herbivores (*Elephas* (*Palaeoloxodon*) *antiquus*, "*Dihoplus*" (*Stephanorhinus*) *kirchbergensis*, *Bison priscus*, *Megaloceros giganteus*, *Mammuthus primigenius*, *Alces alces*, *Cervus elaphus*). Carnivores, such as *Ursus arctos*, *Crocuta crocuta* ssp., *Canis lupus* and *Vulpes vulpes*, are very rare and composed only by one or few specimens. The species composition indicates a typical river mixing of different faunal assemblages from warm (interglacial) and cold (glacial) periods of the Late Pleistocene.

The focus of the present paper is the paleontological description of the first leopard-like fossil record from the alluvial sediment of Po River, considering taphonomy, the morphology, the aging and the relationship with other species recorded at the region in the Late Pleistocene of northern Italy.

2. Material and methods

The found grey-brown and faintly rounded tibia (MSDP 321) is housed in the Museo Paleoantropologico del Po in San Daniele Po (CR), Italy. The bone colouring is typical for the fossil record from alluvial sediments of the Po River, namely partially mineralised remains containing pyrite, limonite, hematite, goethite, manganese, and manganocalcite (Persico et al., 2012). These minerals indicate an anoxic environment of the fossilization, characterized by abundant carbonificated organic plant matter and subsequent reworking in an oxidizing environment. The surface erosion of the edges in particular on the bone head indicates a limited transport (rafting).

Traditional morphometric analysis of osteological remains was employed for precise determination of the felid bone. The measured data is in millimetres; with measurements taken to the

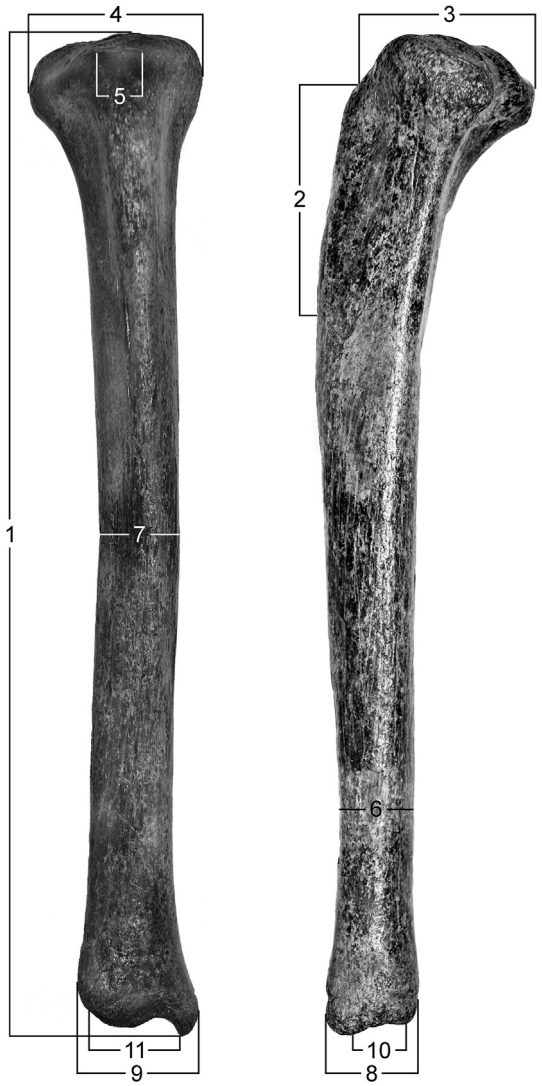

Fig. 2. Measurements of found tibia according to the methodology of Wojtusiak (1953), Gonzáles (2003), and Barycka (2008). For numbered dimensions see Table 1.

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