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Avian fossil assemblages at the onset of the LGM in the eastern Alps: A palaeecological contribution from the Rio Secco Cave (Italy)

Assemblages fossiles d'oiseaux au commencement du dernier maximum glaciaire dans les Alpes oreintales : une contribution paléo-écologique de la grotte du Rio Secco (Italie)

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ABSTRACT

The avian fossil assemblages from the late Pleistocene deposits of the Rio Secco Cave (north-eastern Italy) is presented herein. We studied the layers that date back to the end of MIS3 and the beginning of MIS2, which also contain evidence of Gravettian frequentation dated to 33.5–30 ka cal BP. The systematic analysis revealed the presence of 18 species and other supraspecific taxa that supported palaeoenvironmental reconstructions. Taxa indicate that, at the onset of LGM, site surroundings were characterised by conifer or mixed forests, open grasslands, slow-flowing water bodies and mountain meadows with rocky outcrops, as indicated by *Lagopus muta*. Today, this environment is found above the tree line (beyond 1500–2000 m) and cannot be detected near the site, located at 580 m asl. Noteworthy, is also the finding of the second Italian late Pleistocene fossil record of *Picus canus*.

Mots clés :
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RÉSUMÉ

Les assemblages fossiles d'oiseaux des dépôts du Pléistocène supérieur de la grotte de Rio Secco (Nord-Est de l'Italie) sont ici présentés. Nous avons étudié les niveaux qui remontent à la fin du MIS3 et au début du MIS2, et qui contiennent aussi des preuves d'une fréquentation gravettienne datée de 33,5–30 ka cal. L'analyse systématique révèle la présence de 18 espèces et d'autres taxons supra-spécifiques, qui permettent des reconstitutions paléoenvironnementales. Les taxons indiquent qu'au début du dernier maximum glaciaire, les alentours du site étaient caractérisés par des forêts mixtes ou des forêts

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de conifères, des prairies ouvertes, des cours d'eau à faible intensité et des prairies de montagne à affleurements rocheux, comme l'indique la présence de *Lagopus muta*. Actuellement, cet environnement s'observe au-dessus de la ligne des arbres (au-dessus de 1500–2000 m) et ne peut être trouvé près du site, localisé à 580 m au-dessus du niveau de la mer. À noter qu'il est aussi le lieu de la découverte du second enregistrement fossile italien au Pléistocène supérieur de *Picus canus*.

1. Introduction

Geographic distribution and phenology of birds have changed many times in the past, due to environmental, climatic, ecological and, recently, also anthropic factors, in a dynamic process which is still underway (Bruderer and Salewski, 2008; Gordo, 2007; Holm and Svenning, 2014; Jonzén et al., 2006). As bird species are often linked to particular habitats, especially concerning vegetation, fossil avifaunas give important informations about palaeoenvironment and palaeoclimate. Some authors even consider birds better paleoenvironment indicators than micromammals (Bedetti and Pavia, 2013; Serjeantson, 2009). Despite this, contributions which deal with avian fossil remains have so far been few, and this field seems to receive less attention than the study of mammal fossil remains, maybe because in many fossil assemblages the mammal remains outnumber the bird remains, and also because of the scarcity of bird skeletal comparative collections.

In this work, we present the systematic analysis of avifaunal remains of the Rio Secco Cave, from layers dating to the onset of MIS2. In Italy, several sites yielded avian remains from this period, but just a few in the area of the northern belt of the exposed Great Adriatic Plain, where the Rio Secco Cave is located (Fig. 1). Some of them lack clear quantitative or stratigraphic indications (Bon et al., 1991; Tyrberg, 1998); amongst the ones provided with datings and a reliable stratigraphy, there are Grotta di Fumane (Cassoli and Tagliacozzo, 1994) and Riparo del Broion (Gurioli et al., 2006). The layers D1d-D1e of the Fumane cave deposit, which date back to 31,75–31,43 ka 14 C BP (Higham et al., 2009), provided, among the other bird taxa, *Bubo scandiacus* remains. The presence of this species indicates a colder climate. Riparo del Broion yielded from layers dated 30–32 14 C ka BP (ABA), bird remains that indicate the presence of slow-flowing water bodies. During the Last Glacial Maximum, bird remains from Sandalja II (southern Istria, Croatia) also indicate colder climate conditions, like *Lagopus lagopus* and *Bubo scandiacus* (Tyrberg, 1998). Similar taxa related to colder climatic conditions, including *Bubo scandiacus*, have also been found in the Covolo di Trene in the same period (Romandini and Nannini, 2012; Tonon, 1977). During the cold phases of the LGM, the Italian peninsula, as other parts of Mediterranean Europe (Spain and Balkans) represented refugia for northern species, which moved southwards after glacial expansions (Pellegrino et al., 2014; Sanchez Marco, 2004). Furthermore, the number of bird taxa from open environments (steppe, alpine meadows, etc.), suggests an expansion of these habitats in cold stages. Even several Lateglacial sites of north-eastern Italy and Croatia yielded avian remains that have been studied and have provided numerical or taxonomic data Grotta di Veja E, in the Veneto region; Riparo Soman, Riparo Dalmeri e Riparo Cogola in the Trentino region; Grotte Verdi di Pradis in the Friuli region; Sandalja II e Ljubiceva pecina in Croazia (Fiore et al., 2015; Gala and Tagliacozzo, 2009, 2010; Oros Sršen et al., 2014; Tonon, 1983). Ljubiceva pecina, in southern Istria, provided *Lagopus lagopus* remains, indicating the permanence in this area, in the early stages of Lateglacial, of species of cold environments (Oros Sršen et al., 2014). The avian taxa identified from the other sites, whose deposits date back to the end of Lateglacial, at the Holocene boundary, mostly correspond to the current avifauna of the area.

2. Site and stratigraphy

The Rio Secco Cave is located at an elevation of 580 m asl on the Pradis Plateau in the eastern part of the Carnic PreAlps (Fig. 2), an orographic system of the eastern Alps dissected from north–south and west–east oriented valleys that separate mountains with peaks 2000–2300 m asl. The Pradis Plateau is 6 sq km wide and is enclosed on three sides by mountains peaking from 1148 m to 1369 m and to the south it is bounded by the foothills dissected by the Cosa stream. The plateau rises from 530 m to 590 m and faces the south to the present-day Friulian plain, which is the uppermost belt of a large plain, the Great Adriatic Plain, which emerged during the late Pleistocene and had its maximal southern expansion during the LGM (Antonioli and Vai, 2004; Shackleton et al., 1984). The shelter protects a horizontal gallery, which is almost completely filled with sediments. In 2002, a test-pit revealed the presence of prehistoric settlements. An archaeological excavation has been carried out since 2010 (Peresani et al., 2014).

The sedimentary body of the cave includes 4 stratigraphic Macro-Units, partially affected by bioturbation:

- Macro-Unit 1: includes US2 (Unità Stratigrafica-Stratigraphic Unit 2) and US3. Contains historical settlements and Neolithic/Bronze Age archaeological material;
- Macro-Unit BR1: includes US4 and US6 and is characterized by the presence of angular stones and fragments of karst limestone pavement originated by vault collapses. US4 is composed of blocks and stones with a loamy fine fraction and contains rare lithics. US6 is a thin and discontinuous layer with organic matter and microcharcoal, rare bones, lithic implements and two hearths.

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