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Neanderthal landscapes and subsistence strategies during late Quaternary glacial-interglacial periods: insights from the avian assemblages of Grotta del Cavallo (Apulia, Southern Italy)

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Grotta del Cavallo, a well-known Paleolithic site in Southern Italy (Nardò, Apulia), preserves one of the most important Italian Middle Paleolithic sequences. Its stratigraphic succession records the presence of Neanderthals from Marine Isotope Stage (MIS) 7 to 3, providing substantial insights on their lifeways. Here we present the taxonomic and taphonomic analysis of the bird assemblages associated to Neanderthal occupation. The rich avifaunal assemblages allowed paleoenvironmental and paleoclimatic reconstructions, noticeably improving the reconstruction of the landscape that was exploited by Neanderthals throughout the last glacial-interglacial cycles. Based on the bird taxa identified in the assemblages, Grotta del Cavallo was mainly surrounded by extensive grasslands and shrublands, with scattered open woodland and rocky outcrops, during MIS 7, 6 and 3. The coastal plain, that is currently underwater due to Holocene relative sea-level rise, hosted wetlands in the cooler periods, when it was exposed. In the cool-temperate climatic phase attributed to MIS 3, bird taxa of water and wet environments proportionally increased, as well as coverage-based rarefied richness values. This is possibly due to the expansion of wetland areas, linked to more humid conditions, or to the shorter distance of the wetland settings from the cave, compared to MIS 6 (glacial period). A consequent higher heterogeneity of the landscape is retained to drive the increased richness. The sampling effort allowed to retrieve bird taxa that provided significant paleoclimatic insights, such as *Branta leucopsis*, an arctic breeder, and other species currently spread at higher altitudes, that reinforce previously obtained geochemical derived inference of climate conditions cooler than the present ones. The bird assemblages also provided the first occurrence ever of *Larus genei*, the first Italian occurrence of *Emberiza calandra*, the oldest Italian occurrence of *Podiceps nigricollis*, and the occurrence of *Sylvia communis* (a species rarely retrieved in the fossil record). Ordination analyses of the bird dataset detected the drivers of taphonomic degradation and the agents responsible for the accumulation of the avian bones: modifications are mainly due to physical sin- and post-depositional processes, whereas accumulation is mainly attributed to short-range physical processes of sediment accumulation,

feeding activities of nocturnal raptors and, to a lesser extent, human activities. In detail, traces found on a few bones suggest that Neanderthals introduced some of the birds in the cave with alimentary purposes, providing the earliest Italian evidence of bird exploitation ever.