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Holocene evolution of Lake Shkodra: Multidisciplinary evidence for diachronic landscape change in northern Albania

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ABSTRACT

A multidisciplinary micro-paleontological study of a sediment core (SK19) drilled in the coastal area of Lake Shkodra, northern Albania, integrated with archaeological data from the Projekti Arkeologjikë i Shkodrës (PASH), provides compelling evidence for a long-term relationship between Shkodra's natural environment and its inhabitants. Charophyte and ostracod data recovered from SK19 combined with those already studied from the distal core SK13 (Mazzini et al., 2015), reveal important information concerning the changing characteristics of the water body through time. In particular, the ostracod fauna display a truly Balkanic character with eight taxa endemic to the area.

Palaeoenvironmental analysis of the two cores indicates that a wide marshland extended towards the present eastern coast of the lake, fed discontinuously both by surface- and ground-water, beginning sometime before 12,140 cal yrs BP. For about 7000 years ostracods do not record any significant changes, whereas the Characeae record in the proximal zone displays important variations. Those variations do not match any of the climatic oscillations revealed in previous studies by $\delta^{18}O$ or pollen data, thereby implicating human activities. Ostracods and charophytes indicate that permanent shallow waters occurred in the Shkodra basin only around 5800 cal yrs BP. Historical sources of the Roman Empire indicate a swamp (the *Palus labeatis*), crossed by the River Morača, which flowed into the River Buna.

Evidence for local fires, whether natural or anthropogenic, is recorded in SK13, scattered between 4400 and 1200 yrs BP. From 4400 to 2000 yrs BP, during the Bronze and Iron Age, hill forts ringed the marsh and burial mounds marked its edges. But around 2000 cal yrs BP, a dramatic change in the water body occurred: the disappearance of Characeae. Possibly fires were used for the elimination of natural vegetation and the subsequent cultivation of olive and walnut trees, causing an increase on organic matter input into the lake and thus, resulting on the disappearance of the Characeae due to higher turbidity in lake waters. This change occurred shortly after the arrival of the Romans.

At 1200 cal yrs BP the marshland evolved into the large shallow lake we know today. This change is marked in the ostracod assemblages of both cores and agrees with trends in aquatic and riparian plants and may have allowed or encouraged exponential population growth beginning in the early-middle Medieval period and peaking in the late Medieval, as indicated in PASH settlement data.

The use of different but complementary methods, drawn from palaeontology and archaeology, allowed reconstruction of Shkodra's past landscapes, linking the natural evolution of a Mediterranean lacustrine

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basin to regional population and settlement dynamics. This is the first research project to explore the relationship between natural and cultural landscapes and environmental change in northern Albania, forming the basis for further, more detailed studies.

1. Introduction

Humans and nature interact through time at different scales, often generating various dynamic, reciprocal relationships, the effects of which may be recorded in Holocene sediment records as "impacts." However, given their great diversity, such impacts are not always easily correlated with the archaeological and historical traces of those cultures that once occupied, but then disappeared from, a landscape. Nevertheless, environmental scientists and archaeologists have become increasingly interested in combining datasets in order to understand better the evolution of coupled human-natural systems (e.g., Fisher and Thurston, 1999; Hornborg and Crumley, 2006; Redman, 2005), including those in the Mediterranean basin (e.g., Lespez, 2003; Harris, 2013; Hughes, 2014; Walsh, 2013). In the Eastern Mediterranean, particular attention has been devoted to natural archives recording unambiguous examples of climate forcing during the mid-Holocene transition: lake sediments, cave speleothems and deep-sea sediment cores (Karkanas et al., 2011; Roberts et al., 2011a; Kouli, 2015; Glais et al., 2015). The long transition between the humid early Holocene and the drier late Holocene occurred through three main steps, marked by periods of drier climate (5300–5000 cal yrs BP; 4500–3900 cal yrs BP; 3200–2800 cal yrs BP) (Roberts et al., 2011a; Sadori et al., 2011). Mercuri and Sadori (2014) identified a first clear 'human footprint' on landscape ecology during the Bronze Age in the Eastern Mediterranean. The comparison of different pollen records indicated that by ~2500 cal yrs BP the combination of aridification and human land-use turned the mid-Holocene wooded environment into a mosaic of cultural landscapes.

Across the Balkans, there is evidence for intensified human impact at the end of the Late Bronze Age, at ca. 2800 cal yrs BP in particular (Roberts et al., 2011b). Recent research on the pollen record from Lake Prespa revealed human-induced deforestation at ca. 2000 cal yrs BP (Panagiotopoulos et al., 2013). At nearby Lake Ohrid, the pollen record singled out anthropogenic deforestation from 2500 cal yrs BP (Vogel et al., 2010). Archaeological excavations identified human occupation expansion at ca. 2200 cal yrs BP (Kuzman, 2009). At Lake Butrint, where a strong exploitation of the area started around 2500 cal yrs BP, there are clear signs of warming between 2500 and 2000 cal yrs BP (Morellón et al., 2016).

The aim of our paper is to provide evidence for the links between palaeoenvironmental and cultural landscape changes during the last 13,000 years in a Balkan region only recently studied using modern paleontological and archaeological methods, that of Lake Shkodra in northern Albania.[1]

1.1. Regional setting

According to Boskovic et al. (2004), during the Pleistocene the area presently occupied by Lake Shkodra was a bay connected to the Adriatic Sea filled progressively by sediments deposited by the Morača, Drini, and Bojana rivers along with their tributaries. However, during the Last Pleniglacial, Adriatic sea levels fell dramatically and the Albanian coast was 125–120 m below the present day sea level (Lambeck et al., 2004; Lambeck and Purcell, 2005; Uncu, 2011). This forced the Bojana River to downcut the plain, the evolution of which, during the subsequent Lateglacial, was mainly driven by progressive sea-level rise and consequent flooding (Mazzini et al., 2015).

Shkodra Lake is the largest lake in southeast Europe. Its surface, at 5 m above sea level, can vary between 370 km^2 and 530 km^2, two-thirds of which is in Montenegro and one-third in Albania (Fig. 1). The lake is a crypto-depression with an average water depth of 8 m, filled by the River Morača and drained into the Adriatic by the 41 km long Buna. Just 1 km after leaving the lake, the River Buna receives the waters of the 11 km long major channel of the lower River Drini. Until 1867, the Drini drained straight into the Adriatic Sea near Lezha, about 25 km east of the Buna delta today. However, flood events in 1848, 1858 and 1896, followed by shifts in its channel, allowed the Drini to breach the Buna, a process hastened by canals dug to provide hydropower to mills south of Shkodra and the partial closure of its former river bed. Due to the breach, the water level of Lake Shkodra rises up to 3 m during flood season. Under specific conditions the waters of the Drini may even enter the Lake (Worldbank, 2006). The lake's major inflow is the Morača River, but several small inlets along the north-eastern coast and many karstic springs contribute to the water balance. Recently, palaeoenvironmental reconstruction of the distal part of the lake confirmed its recent origin and that it is the vestigial remnant of a former extended marshland (Mazzini et al., 2015). The evolution to a permanent lake was linked to changes in the hydrological network and sea level (Boskovic et al., 2004; Mazzini et al., 2015).

During the Holocene, this region was home to a series of cultural groups, beginning with Epipaleolithic hunter-collectors (see Gjipali, 2014 for Albania generally). A settlement hiatus probably occurred during the earlier Neolithic (see map, Gjipali, 2014: 61; Galaty and Lafe, 2008), with reoccupation in the Late-Final Neolithic (beginning *ca.* 3500 BCE), and settlement nucleation and expansion during the Bronze Age (Korkuti, 2010). The Early Bronze Age (3100–2000 BCE) is associated with the construction of hill forts and burial mounds, a practice that may have been introduced from the north during the "Cetina" period (2200–2000 BCE) (Galaty et al., 2014). Like much of Albania, the Shkodra region underwent growth and changes in social organization during the Iron Age, resulting in the formation of the so-called Illyrian tribes. Those situated in Shkodra, as described by Greek and Roman writers, were the Abri, Chelidones, Labeates, Grabaei, Ardiaei, Dassarenses, and Selepitani (Wilkes, 1992). These tribes, under their queen, Teuta, ran afoul of the Romans, prompting an invasion in 229 BCE (Wilkes, 1992: 160–162). The region was a Roman colony in the second half of the 1st century AD and was eventually incorporated into the new province of Praevalis under Diocletian (probably in 297 CE) (Hoxha, 2003). Shkodra was an important commercial centre during Medieval times and experienced measurable demographic growth at large sites like Drisht, ancient Drivastium (Jubani, 1986). Shkodra fell to Ottoman Sultan Mehmet II in 1479 CE after a protracted siege.

[1] L. Bejko and M. Galaty are currently completing a five-year regional archaeological project in Shkodra, funded by the United States National Science Foundation (BCS1220016), the Projekti Arkeologjikë i Shkodrës (PASH). The archaeological interpretations in this paper are based on preliminary data collected by PASH.