



Pollen-based quantitative reconstruction of Holocene vegetation in the Varna Lake area using modelling and simulation approach

Количествени реконструкции на растителността в района на Варненското езеро през Холоцена по данни от спорово-поленов анализ

Stoyan Vergiev¹, Mariana Filipova-Marinova¹, Liviu Giosan², Danail Pavlov³, Vladimir Slavchev⁴

Стоян Вергиев¹, Мариана Филипова-Маринова¹, Ливиу Джюсан², Данаил Павлов³, Владимир Славчев⁴

¹ Museum of Natural History – Varna, 41 Maria Louisa Blvd., 9000 Varna, Bulgaria; E-mail: stoyanvergiev@yahoo.com; marianafilipova@yahoo.com

² Woods Hole Oceanographic Institution, 360 Woods Hole Rd., Woods Hole, MA 02543, USA; E-mail: lgiosan@whoi.edu

³ Society of Innovative Ecologists of Bulgaria, 10 Dr. Bassanovich str., 9010 Varna, Bulgaria; E-mail: danailpavlov@gmail.com

⁴ Archaeological Museum – Varna, 41 Maria Louisa Blvd., 9000 Varna, Bulgaria; E-mail: vladosl@yahoo.com

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Analysis of the fossil pollen assemblages of lacustrine sediments can be used to study the vegetation dynamics and human impact on the natural vegetation. Different models describe the spread and accumulation of pollen around the sample site and provide an excellent opportunity for quantitative reconstruction of vegetation coverage.

The Varna Lake is the largest by volume and deepest liman along the Bulgarian Black Sea Coast, and therefore, pollen found in its sediment samples is representative of the regional vegetation from a large area.

This report aims to create a calibrated model on the basis of modern pollen, vegetation and environmental data and then to reconstruct the past vegetation and to simulate landscapes in the GIS environment.

A detailed pollen analysis was performed on the 870 cm of the 995 cm Core-3 obtained from the Varna Lake at a water depth of 6 m. An age/depth model based on 7 AMS radiocarbon dating was constructed (Filipova-Marinova et al., 2013). The Extended R-Value (ERV) model was used to relate pollen percentages to vegetation composition within a certain area, by taking the pollen productivities and fall speed of different taxa into account (Sugita, 1994). Models of pollen dispersal and deposition were applied in order to reconstruct likely past landscape scenarios from fossil pollen assemblages using the software suite HUMPOL v.3 (Bunting, Middleton, 2005). Vegetation communities

and their composition were simulated in GIS environments and possible vegetation maps were drawn.

The modern pollen samples together with the corresponding vegetation data were collected and digital maps were created. Five vegetation communities are recognized as well as two types of non-pollen producing areas. The application of the ERV model for simulation of contemporary landscape around Varna Lake calculates distance weighted plant abundance estimates of pollen productivity for use as correction factors.

Measurement of goodness-of-fit between pollen and vegetation data are presented as the Relevant Source Area of Pollen (RSAP) by calculating the likelihood function scores against the distance from the sample point. Three submodels of the ERV model are tested and show similar results but ERV model 3 was selected and gives an RSAP of 4300 m for this landscape.

Standard intuitive interpretation of the pollen assemblages suggest six stages of development of vegetation in the Varna Lake area. Numerous 50 km by 30 km landscape simulations were performed at the four time-windows in the past (Fig. 1).

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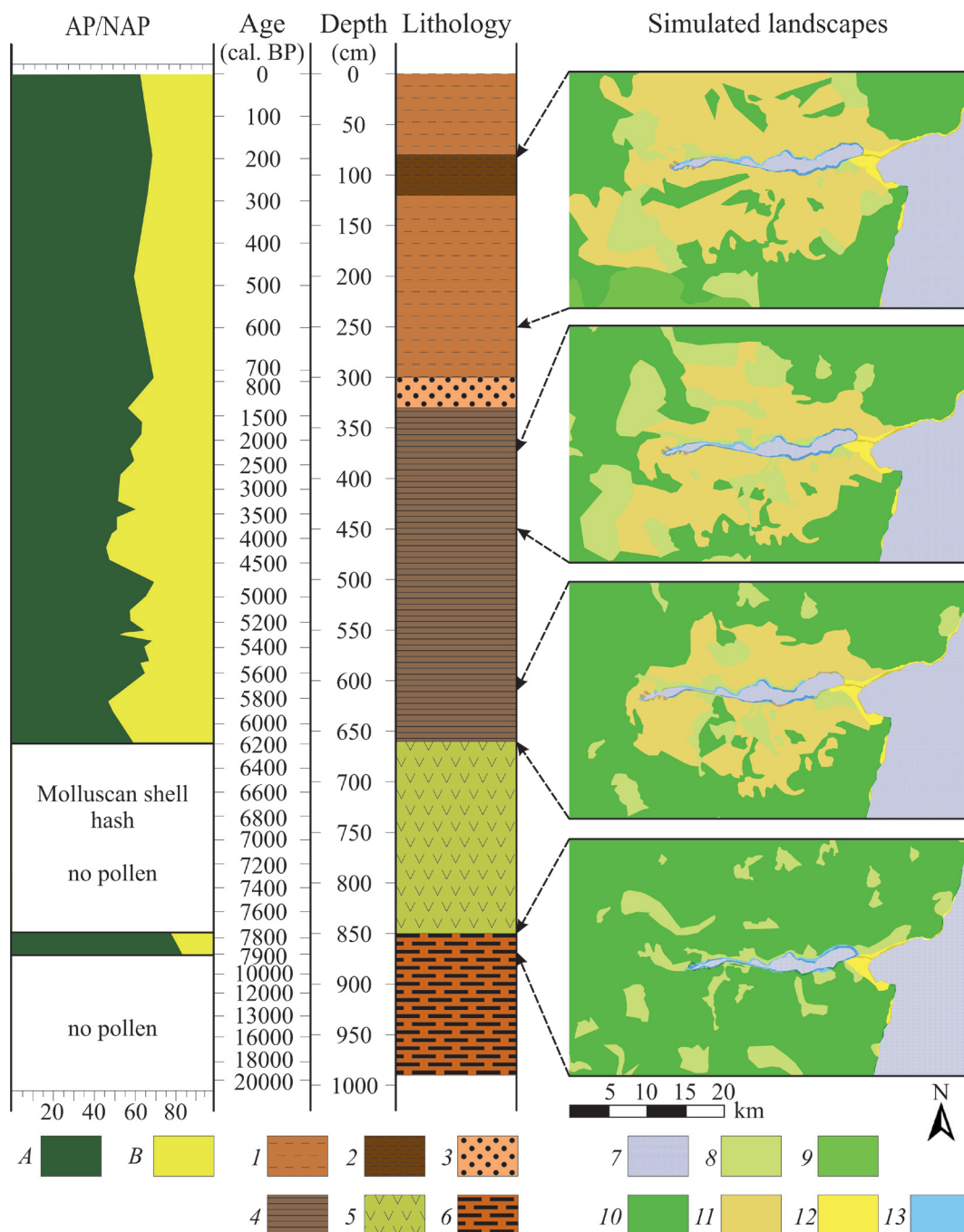


Fig. 1. Simulated landscapes around the Varna Lake in four time-windows

A, arboreal plants (AP – trees and shrubs); *B*, non-arboreal plants (NAP – herbaceous plants); lithological description of the Core-3: 1, beige-grayish clays, enriched in sand, 2, grayish clay, 3, grayish-yellow sandy-clayey layer, 4, laminated clay – alternation of light gray and dark gray laminae, 5, molluscan shell hash, 6, massive brownish-gray clay; non-pollen producing areas: 7, present water surface; vegetation communities: 8, grassland, 9, riverine forests (longoz forests), 10, mixed oak and hornbeam forest, 11, arable areas, 12, psammophytic communities, 13, marshy areas

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