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ANCIENT BURIAL MOUNDS - BIODIVERSITY HOTSPOTS AND REFUGEES FOR NATURAL FLORA AND VEGETATION

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Abstract. Bulgaria is enormously rich in historical monuments. Burial mounds are one of the most numerous among them. They are spread all over the country but are localized in lowlands where active agriculture takes place. Patches of semi-natural vegetation are often preserved on the ancient burial mounds most of which are remnants from thousands years ago. The burial mounds which are generally surrounded by vast agricultural fields of monocultures often host the remnants of autochthonous flora. Besides being hotspots for biodiversity preservation, the ancient burial mounds are ideal objects for testing the theory of island biogeography. In our study we selected 577 mounds distributed near equally in northern and southern Bulgaria. Around each one mound a buffer of 200 m was outlined and the land use types were mapped aiming to identify the influence of land use on the floristic diversity. Our methodology includes sampling all vascular plants and their abundance within two sample plots of 25 m2 positioned in the middle of north and south facing slopes. The scientific goal of our research is to reveal the significance of the burial mounds not only as cultural value, but also as natural treasure for the country. This

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would additionally emphasise their attraction as touristic objects.

Key words: biodiversity conservation, fragmentation, historical monuments, kurgans

INTRODUCTION

Land use changes and remarkable agricultural intensification during the past decades have resulted in a considerable decrease in natural and semi-natural habitats in the whole World. These changes involved the transformation of the natural terrestrial habitats into agricultural and urban areas, which lead to a serious loss and degradation of their vegetation (Tilman 1999; Williams e t al. 2009). These processes are particularly pronounced in grassland ecosystems, where about 45% of the temperate grasslands have been converted by human actions (H oekstra et al. 2005). Permanent grasslands and especially steppe habitats face serious threats, because their soils are excellent for arable farming ***(e.g.*** chernozem; H olzel e t al. 2002).

In the lowlands where the agricultural activity is the most intensive the natural vegetation is generally present only in small fragments (Deak et al. 2019a). In Bulgaria patches of semi-natural vegetation are often preserved on the mounds which are remnants from ancient Thracian burial practices. The country is especially rich in these historical monuments. The burial mounds host remnants of the autochthonous flora which is surrounded sometimes by vast agricultural fields of monocultures. According to Sudnik-Wojcikowska & Moysiyenko (2012) Paczoski was the first who has recognized the importance of kurgans in the restoration of the steppic vegetation. During his expedition to Bulgaria, where he visited the mound of King Wladyslaw III Warnenczyk, he wrote: "I wish to describe the plant species composition of this kurgan, because this type of vegetation, as well as the vegetation of Ukrainian kurgans, can play an important role in the restitution of the steppe that was subjected to the strongest anthropogenic transformation" (Paczoski 1933, p. 156).

Bulgarian burial mounds are objects for archaeological surveys since more than 150 years. The terms mogili, mounds, tumuli, kurgans, barrows, or halom describe similar hemispheric landscape structures that are widespread in the steppe and forest steppe zones of Eurasia from Hungary to Mongolia (Deak et al. 2016). Nobody has studied flora on burial mounds in Bulgaria so far, even though burial mounds integrate natural and cultural values and provide several important ecosystem services.

Since the beginning of the 21st century, the number of botanical studies of kurgans in Europe has increased. Information about the flora and vegetation developed on the kurgans exists for the whole area of Hungary (Penksza & Joo 2002; B arczi 2003, T o th 2006, D eak e t al. 2019b), for a part of Ukraine (Sudnik-W ojcikowska & Moysiyenko 2012, 2013) and Poland (Cw ener & Towpasz 2003; C w ener 2004).

Besides being hotspots for biodiversity preservation, the ancient burial mounds

are ideal objects for testing the theory of island biogeography (MacArthur & Wilson 1967) or the mosaic concept (Duelli 1997). Whatever theoretical background is followed, the burial mounds can be considered as the remnants of the ***natural*** areas within the ***agricultural sea.*** We can measure and record the species richness, as well as the abundance and occurrence of individual species growing on them. Therefore, they could serve as a unique experimental field for studying the role of fragmentation and isolation in shaping vegetation patterns. These historical monuments have existed for millennia and provide invaluable information about the semi-natural vegetation and serve as source of diaspores for nature conservation activities.

In 2019 the Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences started a project financed by the National Science Fund aiming to fill the knowledge gap about the flora and vegetation of the burial mounds in Bulgaria and to reveal their importance as semi-natural habitat patches in modified agricultural landscapes. The project duration is 36 months. It is conducted in collaboration with the Hungarian colleagues from the Seed Research Group in Pest.

MATERIAL AND METHODS

We intended to observe as much as possible mounds. In collaboration with the National Archaeological Institute with Museum at the Bulgarian Academy of Sciences we decided to use existing data included in the Archaeological map of Bulgaria. The Archaeological map of Bulgaria is a database containing information for different archaeological sites in the country and is used for scientific research, preservation and promotion of national archaeological heritage. It includes approximately 11, 000 burial mounds distributed all over the country. We randomly selected 577 mounds distributed near equally in northern and southern Bulgaria. All mounds were verified in terms of location and contemporary condition by using orthophoto images and topographic maps. Visual observation of their vegetation coverage was additionally performed by Google maps imagery. The land cover was assessed in percentage herbaceous/woody vegetation coverage. Around each mound a buffer of 200 m was outlined and the land use types were delineated **(Fig. 1).** Six land use types were identified: annual crops, perennial crops, forests, grasslands, other semi-natural lands and urban areas. Further on we selected mounds for field sampling. The selected mounds represent different types of land use in their surroundings and different land cover on the mounds.

Our intention is to sample 120 burial mounds in terms of their floristic diversity including vascular plants, bryophytes and lichens. Our methodology includes two sample plots of 25 m2 situated in the middle of the north and south facing slopes **(Fig. 2).** Data about plant species diversity and abundance is collected in each plot. Species lists are completed by an additional survey all around the mound. We propose a functional trait-based ecological research on the flora of the mounds to improve

Fig. 1. Buffer of 200 m were outlined around each burial mound with land use types defined

Fig. 2. Sample plot

our understanding of plant communities' structure. For this purpose, original field data will be collected and international databases will be considered. This trait based research could further be used to evaluate the changes in plant diversity and ecosystem function.

DISCUSSION

The human wellbeing (C l a r k 2014) depends on the knowledge and ability for the sustainable management of the ecosystems. Therefore, a step forward in improving the way we manage the ecosystems is to enlarge our knowledge about their extent, condition and capacity. The project offers new knowledge about the importance of the burial mounds in Bulgaria as refugee for natural biodiversity and provision of ecosystem services. The project provides unique design combining two far different aspects of human activity - contemporary development and preserved historical past. It also establishes a bridge between history and biology which has rarely attracted such different groups of scientists.

The appearance of burial mounds is associated with ***Yamna culture,*** coming into the Balkans from Russian steppes during the end of 4th millennium BC. Later on the

burial mounds become common practice in Thracian funeral rituals. This practice lasts till the 4th century AD when the Christianity becomes leading religion. According to K ito v (1993) the number of Thracian mounds in Bulgaria exceeds 50,000, but their number is probably higher. In the past times they certainly have been more numerous but due to treasure hunting, constructions, military activities and archaeological investigations during the past century thousands mounds have been destroyed. These landscape features have been preserved for millennia due to their spiritual significance and also because they could hardly be ploughed as their original height more often ranges between 3 and 15 m (K ito v 1993; **Fig. 3).**

Fig. 3. An example of burial mound surrounded by agricultural fields.

Burial mounds increase the landscape scale biodiversity of human transformed landscapes. In the same time burial mounds are influenced by human activities such as treasure hunting, afforestation, grazing or abandonment. We observed in the field that most of the visited mounds are disturbed by treasure hunters. The physical disturbances caused by the digging favors the establishment of woody plants and also promote the invasion of weeds and alien species. Lower parts of the mounds are usually rich in weeds established by diaspores from the neighboring agricultural fields. At some places, unfortunately we observed waste disposal on mounds close to roads and urban areas.

During the summer of 2019 we sampled jointly with Hungarian colleagues 8 mounds in the region of Plovdiv **(Fig. 4).** Floristic data was collected together with measurements of climatic and soil parameters. All samples are now in a process of analyses. Aim of this sampling is to compare the kurgans in Bulgaria with these in

Hungary in terms of species functional diversity and habitat preferences.

Fig. 4. Common field work with Hungarian colleagues.

For the future conservation measures there is a need of specialised database which could provide up-to-date information about the biodiversity of the mounds and support the work of the decision makers in designating national and regional level protection and restoration plans. Such databases are under preparation for the whole area of Hungary and for a part of Ukraine (Toth 2006; Sudnik-Wojcikowska & Moysiyenko 2012, 2013; Bede 2014). Recently a new Eurasian

kurgan database was established (Deak et al. 2019c). It aims to serve as a public repository of basic kurgan data that can be used by a wide range of end-users. It provides an easy to use data for conservation managers and landscape planners who require baseline information on the location, typical land use type and threatening factors present on the kurgans.

Another significance of the project implementation is to attract farm owners to enhance their knowledge about the importance of ecological approach in agricultural practices. There is a trend in European Common Agricultural Policy (CAP) which aims to provide additional financial support to the farmers to adopt agricultural practices which are beneficial for biodiversity, environment and climate. Following the EC Regulation № 1307/2013 farm owners must fulfill requirements to protect Ecological Focus Areas (EFA). The EFA are territories within the arable lands aiming at safeguarding and improving biodiversity on farms. This fits in particular with the

objective 3A of the EU biodiversity strategy to 2020 (COM/2011/0244). EFAs can be features such as fallow land, field margins, hedges and trees or buffer strips which directly benefit biodiversity. They can also include specific productive areas whose effect on biodiversity is indirect through a lower use of inputs such as fertilizers. EFAs in general are beneficial also for sustaining ecosystem services (such as pollination, pest and disease control and soil erosion).

Some of the EFAs, the so called 'landscape features', have a particular interest for biodiversity conservation. They include: 'hedges or wooded strips', 'isolated trees', 'trees in line', 'trees in groups', 'field margins', 'ponds', 'ditches', 'traditional stone walls' and 'other landscape features'. The EC Regulation № 1307/2013 provides opportunity for each member state to select "other landscape features" and determine their significance for conservation. Bulgaria, which has adopted Regulation № 1307/2013 in 2014, accepted all landscape features besides stone walls and has not appointed any 'other feature'. At the same time ancient monuments or archaeological sites are included in the list of ***Other landscape features*** in Denmark, Ireland, Hungary and UK Northern Ireland (EC 2015). Therefore in these states the conservation of cultural and historical heritage is combined with the conservation of natural habitats with characteristic flora and fauna. In Bulgaria historical monuments are protected by the Cultural heritage law, but the protection is not extended to their flora and fauna. Hungary is the only country where all kurgans are protected by the nature conservation law regardless whether they are situated in a protected area or not.

All mentioned above emphasizes the scientific goals of the project implementation to reveal the significance of the burial mounds not only as cultural treasure, but also as natural treasure for the country. Remaining outside EFAs these landscape features will be overlooked in biodiversity conservation assessments in the context of intensive agriculture. Project results will provide information for the broad public and will enhance the local stakeholders' interest about the significance of the historical landscape features. We hope this will enlarge the tourist interest to

the historical monuments also as spots of natural heritage.

Besides the particular importance of burial mounds in biodiversity preservation, the project results will allow for further analyses on the effects of fragmentation and isolation on grasslands using collected field data from Bulgaria. Such data is very scarce for the country so far. The burial mounds are preserved as cultural heritage, but we expect that the project results will offer arguments also for preservation their natural heritage. This would additionally emphasise their attraction as touristic objects. The new knowledge will emphasize the importance of national history and culture in combination with the natural heritage .

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication

of this article.

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