Abstracts

of the scientific papers of

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7.1 Abstracts of the publications grouped by criterion ”B.4”

[B4.1] Vergiev, S. 2019. Tall Wheatgrass (*Thinopyrum ponticum*): Flood Resilience, Growth Response to Sea Water Immersion, and Its Capacity for Erosion and Flooding Control of Coastal Areas. Environments, 6(9), 103. ISSN 2076-3298

Integrated coastal zone management proposes nature-based mitigation strategies based on the replacement of artificial coastal stabilization and protection structures with dunes stabilized with plant species. These psammophytes stabilize sands and act as supporters, increasing dunes' ability to reduce storm damages and effectively minimize erosion with minimal negative impacts to natural ecosystems. That is why searching for native salt-tolerant plants with extensive root systems and studying their capacity for erosion and flooding control is fundamental to the practice of ecologically-sound ecosystem services. The aim of the present study is to define the effects of flooding stress on a number of wheatgrass (*Thinopyrum ponticum*) plant life aspects (survival ability, viability, and growth response) in order to determine wheatgrass's capacity as dune stabilizer. Conducted experiments established that *T. ponticum* was very tolerant to immersion impact and salt and oxygen deficiency stress, and its rhizomes were able to regenerate after 30 days in seawater. The temporal expression of its survival is presented as critical decomposition time (CDT) by linking the maximum duration of floods along the Bulgarian Black Sea Coast and the resilience of tall wheatgrass in flooding simulations. A statistical analysis of the experimental data demonstrated that immersion in sea water increases rhizome viability, biomass, and allocation to root biomass, whereas other factors, such as the duration of immersion, salinity, and temperatures of sea water have no significant effect. According to flood resilience and growth response to sea water submergence, *T. ponticum* demonstrated high potential to be a dune stabilizer.

[B4.2] Vergiev, S. 2019. Comparative study of the capacity of three plant species from the Poaceae family for erosion and flooding control of coastal areas. In Georgiev & Guedes Soares (eds), Sustainable Development and Innovations in Marine Technologies – Proceedings of the IMAM Congress Varna 2019, CRC PRESS/BALKEMA, 597-602. ISBN 978-0-367-40951-7.

Sustainable development of coastal areas requires replacement of artificial coastal stabilization and protection structures with well adapted plants with extensive root systems. In order to compare the capacity of three plant species from family Poaceae for erosion and flooding control, a multidisciplinary study based on GIS mapping and modeling of the beach between Kamchia River and Fandakliiska River (Northeastern Bulgaria) and results from simulated

flooding experiments was conducted. A strong correlation between percentage participation of the investigated species in dune vegetation and dynamic of the shoreline was observed. Polygons with prevailing of *Leymus racemosus* subsp. *sabulosus* had a more stable coastline, unlike polygons with predominance of *Ammophila arenaria* and *Elymus elongatus*. The investigated species showed high tolerance to sea water immersion and high viability. *L. racemosus* subsp. *sabulosus* demonstrated the highest potential to be a key species for dune stabilization, followed by *A. arenaria* and *E. elongatus*.

[B4.3] Vergiev, S. 2018. The impact of sea water immersion on the viability of psammophilous species *Carex colchica* and its capacity as dune stabilizer. Comptes Rendus de l'Academie Bulgare Des Sciences, 71(5):648-654. ISSN 1310-1331 (Thomson Reuters IF2013 = 0.321)

Unusual storms along the Bulgarian Black Sea Coast may cause flooding, erosion and therefore destruction of plant communities of psammophytes which dominate sand dunes. In such cases *Carex colchica* J. Gay occupies territories from dune pioneers and becomes a major dune stabilizer. This study aims to establish the viability of this species and possible negative consequences during simulated flooding experiments and thereby to investigate its capacity as dune stabilizer. Conducted experiments established that *C. colchica* was very tolerant to immersion impact and salt stress. Whole plants stay viable longer than the flood with a maximum duration along the Bulgarian Black Sea Coast, and rhizomes were able to regenerate after 30 days in seawater. Statistical analysis of experimental data demonstrates that immersion in sea water increases rhizomes viability, biomass and allocation to root biomass, whereas other factors, such as duration of immersion and temperatures of sea water have no significant effect. *C. colchica* was less tolerant to water immersion than other psammophytes, but demonstrated a high potential to be a key species for dune stabilization and could contribute to the protection of coastal sands during storms.

[B4.4] Vergiev, S. 2017. Comparative Study of the Response of Four Native to the Bulgarian Black Sea Coast Psammophytes to Simulated Flooding Experiments. Annual Research and Review in Biology, 60(1):1–8. ISSN: 2347-565X.

This study aimed 1) to determine and compare the effects of flooding stress, caused by storms on whole plants of four native to the Bulgarian Black Sea Coast psammophytes and how long their rhizomes can remain viable in sea water; and 2) to investigate post-immersion changes in

plant biomass and allocation to above- and below-ground biomass in order to determine and compare their capacity as dune stabilizers.

Two simulated flooding experiments were conducted. In the first experiment, whole plants were immersed in sea water for 20 days. Visible morphological changes of leaves, stems and roots are recorded and assessed in 12 parameters. In the second experiment, rhizomes were immersed in sea water, were planted and allow growing for one month before harvesting in order to establish rhizomes viability, biomass and root/shoot ratio.

Conducted flooding experiments established that investigated psammophytes were very tolerant to immersion impact and salt stress. Whole plants stay viable longer than the flood with a maximum duration along the Bulgarian Black Sea Coast, and rhizomes were able to regenerate after 30 days in seawater. Statistical analysis of experimental data demonstrates that immersion in sea water increases rhizomes viability, biomass and allocation to root biomass, whereas other factors, such as duration of immersion and temperatures of sea water have not significant effect.

Investigated psammophytes show high tolerance to sea water immersion and high viability during the simulated flooding experiments. Investigated species from family Cyperaceae are less tolerant to water immersion than those from Poaceae. According to growth response, *Leymus racemosus* subsp. *sabulosus* demonstrates a high potential to be a key species for dune stabilization, followed by *Ammophila arenaria, Carex colchica* and *Galilea mucronata*. All psammophytes could contribute to the protection of coastal sands during storms.

[B4.5] Vergiev, S., Filipova-Marinova, M., Trifonova, E., Kotsev, I., Pavlov, D. 2013. The Impact of seawater immersion on viability of the psamophilous species *Leymus racemosus* subsp. *sabulosus* and *Ammophila arenaria*. Comptes rendus de l'Académie bulgare des Sciences, 66(2):212–216. ISSN 1310-1331 (Thomson Reuters IF = 0.198)

Leymus racemosus (Lam.) Tzvelev subsp. *sabulosus* (M. Bieb.) Tzvelev (mammoth wildrye) and *Ammophila arenaria* (L.) Link (marram grass) are perennial, psammophilous species which dominate sand dunes due to their biological characteristics. Their communities have an important role in the formation of the natural vegetation cover of coastal sand strips along the Bulgarian Black Sea Coast. This study provides the first systematic analysis of tolerance of *L. racemosus* subsp. *sabulosus* and *A. arenaria* to sea water immersion along the Bulgarian Black Sea Coast. It aims to determine effects of flooding stress on whole plants and how long rhizomes can remain viable in sea water. Two experiments establish that decomposition of leaves of immersed plants starts from the 7th day. A growth of stems and root sprouts is observed on the same day. There are no visible decompositions of stems, roots and rhizomes till the end of the experiment (20th day). Rhizomes from the investigated species are able to

regenerate after 30 days of submergence and bud viability appears to be enhanced slightly by sea water. *L. racemosus* subsp. *sabulosus* shows higher bud viability than *A. arenaria* . The possible negative consequences of flooding to *L. racemosus* and *A. arenaria* communities based on experimental results, hydrodynamical modelling, detailed topography, bathymetry surveys and detailed GIS mapping on Panorama Beach are discussed.

[B4.6] Hoggart, S., Hanley, M., Parker, D., Simmonds, D., Bilton, D., Filipova-Marinova, M., Franklin, E., Kotsev, I., Penning-Rowsell, E., Rundle, S., Trifonova, E., **Vergiev, S.**, White, A., Thompson, R. 2014. The consequences of doing nothing: The effects of seawater flooding on coastal zones. Coastal Engineering, 87:169–182. ISSN 0378-3839 (Thomson Reuters IF = 2.062)

Sea level rise and an increased frequency and severity of storm surge events due to climate change are likely to increase the susceptibility of low lying coastal areas to seawater flooding. An integral part of any coastal management strategy throughout European countries is the "do nothing" scenario; this is the benchmark against which putative intervention strategies are evaluated. While the prime concern of a flood defense scheme appraisal often focuses on the sustained financial "benefits" of an intervention, intrinsic to a complete multicriteria analysis is a comprehensive evaluation of the ecological and social consequences of coastal flooding, reflecting the needs of end users and satisfying relevant national and international policies.

An ecological perspective may be usefully employed to examine the impact of the do nothing option on coastal environments (e.g. estuaries, sand dunes and grasslands) and businesses. Although at first sight coastal environmental and business systems appear quite different, they have similarities in that both are vulnerable and susceptible to flood damage or loss and both may be analyzed by employing ecological, adaptive, resilience frameworks. From an ecological perspective many coastal environments are of international conservation importance and provide important ecosystem services including coastal protection, nutrient cycling, carbon sequestration, food production and recreation. Nonetheless, despite their potential vulnerability to coastal flooding, our understanding of the effects of salinity on the biological response of many coastal plants and animals is extremely limited. We show here how plant physiology and patterns of plant and invertebrate distribution are impacted by sea water flooding. We also present responses of model plants to sea water inundation based on the Intergovernmental Panel on Climate Change (IPCC) (2007) predictions of sea level rise and storm surge events. Results showed that coastal habitats surveyed are relatively resilient to flooding due to their species rich nature and their ability to adapt to flooding. However specific groups of plants such as grasses are more affected by flooding and less able to recover.

The socio-economic dimensions of doing nothing are addressed in relation to the impacts of coastal flooding specifically on business activity, which has received little attention to date.

Here the focus is on the presence or absence of business disruption and recovery plans as a means of increasing a business's adaptation and resilience to flooding. Results show that some businesses, particularly small ones, are more likely to fail to recover from flooding due to lack of forward planning. Therefore from an ecological perspective business recovery post flooding is likely to be dependent upon ability to adapt, which itself depends upon the construction of resilient business environments.

[B4.7] Narayan, S., Nicholls, R., Trifonova, E., Filipova – Marinova, M., Kotsev, I., **Vergiev, S.**, Hanson, S., Clarke, D. 2012. Coastal habitats within flood risk assessments: role of the 2D SPR approach. Coastal Engineering Proceedings, 1(33) management.12:1–9. ISBN: 978-0-9896611-1-9.

Coastal habitats are highly threatened ecosystems that are sensitive to complex sets of natural and human drivers. Europe's coastal habitats are protected from damage due to human activity by the EU Habitats Directive, and are required to be mapped within flood risk assessments by the EU Floods Directive. Ecological vulnerability and risk assessments are a common way of assessing the impacts on these habitats due to human and natural drivers. Coastal flood risk assessments therefore often include assessments of the vulnerability of coastal habitats. Flood risk assessments also evaluate, where relevant, the mitigation services provided by coastal habitats. The two aspects of coastal habitats – their flood mitigation service and their ecological vulnerability are strongly correlated; however these are usually treated separately within flood risk assessments. One of the goals of the EU THESEUS project is the integrated consideration of coastal habitats within flood risk assessments. This paper investigates the integration within flood risk assessments of the two aspects of coastal habitats using the 2D SPR conceptual model. The construction of the model is first illustrated by application to a generic study site. The model is then applied to a case-study where data on habitat elevations and vulnerabilities to flood events have been collected. The model provides a unique and robust means of combining information on ecological vulnerability indices for different habitat associations with information on their distribution and spatial relationships within the coastal floodplain. Used in conjunction with information on habitat vulnerability indices, the conceptual model serves as a powerful tool for integrated and structured consideration of coastal habitats within flood risk assessments.

[B4.8] Trifonova, E., Valchev, N., Keremedchiev, S., Kotsev, I., Eftimova, P., Todorova, V., Konsulova, T., Doncheva, V., Filipova-Marinova, M., **Vergiev, S.**, Petkov, J., Nikolaev, R., de Vries, W., Silva, R., Andreeva, N., Galiatsatou, P., Kirilova, D., Krestenitis, Y., Polonsky, A., Androulidakis, I., Kombiadou, K., Weisse, R., Mendoza, E., Duran, G., Karambas, T., Koftis, T., Prinos, P., Kuznetsov, S., Saprykina, Y. 2014. Mitigating flood and erosion risk using sediment management for a tourist city: Varna, Bulgaria. – In: Zanuttigh, B., Nicholls, R., Vanderlinden, J., Burcharth, H., Thompson, R. (Eds.). Coastal risk management in a changing climate. Elsevier. Pp. 358–383. ISBN: 978-0-12-397310-8.

The article demonstrated the practical application of a holistic approach to flood and erosion assessment by linking a wide variety of physical, social, economic, and ecological factors. The focus was set to biodiversity conservation. The description of this Varna city site allows the identification of key drivers of future risk at the coastal areas, weak points of present risk assessment and management, and consequent main challenges to be addressed. Suitable mitigation options and their benefits are also identified, and example application of methodologies for the selection of the best portfolio to preserve the areas and promote their sustainable development is provided.

[B4.9] Markov G., **Vergiev S.** 2010. First report of cf. *Protanancus* (Mammalia, Proboscidea, Amebelodontidae) from Europe. Geodiversitas, 32 (3):493–500. ISSN: 1280-9659 (IF Thomson Reuters = 0.986)

Three molars from northeast Bulgaria are attributed to cf. *Protanancus* sp., based on their distinctive morphology. These are the first finds from Europe referable to the amebelodontid genus *Protanancus*, hitherto known from Africa and Asia. The material from NE Bulgaria differs from both named species of the genus, *P. macinnesi* and *P. chinjiensis*, displaying a combination of derived and primitive characters.

[B4.10] Markov, G., **Vergiev, S.** 2012. *Tetralophodon* (Mammalia: Proboscidea) from the vicinities of Varna, Northeast Bulgaria. Historia naturalis bulgarica, 20:151–156. ISSN 0205-3640.

A previously unpublished molar fragment from the collections of the Varna Regional Museum of History – Department of Natural History, is referable to *Tetralophodon*, a genus represented in the fossil fauna of Bulgaria by the Turolian species *T. atticus*. In its morphology, however, the molar differs from the few known specimens of *T. atticus* and is closer to *T. longirostris*, a species common in pre-Turolian localities of Europe but so far not known from Bulgaria – despite previous reports based on misidentified materials. No Turolian localities are known from the area around Varna – which has yielded proboscideans of certain pre-Turolian age – and the specimen described here is the only find from Bulgaria so far which could belong to *T. longirostris*.

[B4.11] Vergiev, S., Markov, G. 2012. Fossil Proboscideans (Mammalia) from the Collections of the Varna Regional Museum of History. Acta zoologica bulgarica, 64 (4): 427–438. ISSN 0324-0770. (IF Thomson Reuters = 0.309)

The paper describes the fossil proboscideans stored in the Varna Regional Museum of History – Department of Natural History in Varna, Northeast Bulgaria. Small but important, the collection contains remains of proboscidean taxa ranging from the middle Miocene to the Pleistocene. Although far from numerous, specimens at the VRMH include a pre-Turolian (? middle Miocene) elephantoid close in its morphology to *Gomphotherium angustidens*. Staro Oryahovo (unidentified elephantoids of apparent pre-Turolian age) and Botevo (Mammuthus) are new additions to the list of Bugarian fossiliferous localities. Vetren (*Prodeinotherium bavaricum, Deinotherium giganteum,* cf. *Protanancus* sp., cf. *Gomphotherium angustidens* and *Mammuthus*) was known until recently only as a locality yielding Pleistocene mammoths. Thus, the collection demonstrates the high potential interest of the areas around Varna and Silistra in NE Bulgaria, which have yielded most of the pre-Turolian proboscideans from the country. Further research on the fossiliferous localities near Varna and Silistra would doubtlessly contribute to the understanding of proboscidean evolution on the territory of present-day Bulgaria, and Europe in general.

[B4.12] Vergiev, S., Markov, G. 2010. A mandible of *Deinotherium* (Mammalia: Proboscidea) from Aksakovo near Varna, Northeast Bulgaria. Palaeodiversity, 3:239–245. ISSN 1867-6294.

The paper describes a mandible from Aksakovo near Varna, NE Bulgaria, referred to *Deinotherium giganteum* on the base of dental size, since morphology of p3 is not directly observable due to poor preservation. Also from Aksakovo, *Prodeinotherium bavaricum* is known with a molar recovered and published in the 1960s. The two deinotheriid specimens are the only fossil finds from Aksakovo so far and, while not associated, indicate a pre-Turolian, most probably middle Miocene age for the locality. Pre-Turolian land vertebrates are rare in Bulgaria, coming mostly from the northeast part of the country, mainly from the vicinities of Varna on the Black Sea coast. This is the first *Deinotherium giganteum* mandible from Bulgaria, with most of the deinotheriid finds from the country belonging to the Turolian species *Deinotherium gigantissimum*.

[B4.13] Vergiev, S., Filipova-Marinova, M. 2020. Pollen-based paleoclimate reconstructions of North-Eastern Bulgaria during the last 7000 years using modern analog technique (MAT). Review of the Bulgarian geological society. 81(3):155-157.

The aim of the present study is to reconstruct the palaeoclimate variables in North-Eastern Bulgaria during the last 7000 years, based on the pollen analysis from 2 lacustrine cores and using modern analogue technique (MAT). This method is based on the collection of modern surface pollen samples and on the comparison of the presence and percentage participation of pollen types in them with modern climatic data, thus establishing the vegetation-pollen-climate correlation. Climatic variables related to modern vegetation can be associated with the time and place of the fossil sample that is being reconstructed within a given geographical area.

Pollen data were used for the reconstruction of four parameters: the average annual temperature, the average temperature of the warm and cold half-year and the average annual precipitation for North-eastern Bulgaria for the last 7000 years.

Based on the spore-pollen analysis, 3 climatic intervals were separated. During the first interval (7000–5000 cal. BP) the highest values of the thermal parameters were reported, which coincides with the Holocene climatic optimum. Precipitation is relatively high, but lower than the estimated average for the Atlantic period.

The curves of the thermal parameters in the range 5000–3000 cal. yr. BP showed dynamics and downward trend. The last time interval (after 3000 cal. Year BP) is characterized by homogeneity of climatic parameters, which show almost identical values.

7.4 Abstracts of the publications grouped by criterion ”G.8”

[Г8.1] Vergiev, S. 2019. Detailed GIS mapping of plants with conservation status in Central Group of protected area Pobiti Kamani (Northeastern Bulgaria). Научни трудове на Съюза на учените в България–Пловдив, Серия В – Техника и технологии, 17: 253-256. ISSN 1311-9419.

The aim of the present study is to check the current conservation status of rare, endemic, vulnerable, threatened and protected plant species in Central Group (Northern and Southern zones) of protected area Pobiti Kamani (Stone Forest). In order to investigate the distribution of 9 plant communities (*Alyssum borzaeanum*, *Anthemis regis-borisii*, *Arenaria rigida*, *Centaurea arenaria*, *Dianthus nardiformis*, *Ephedra distachya*, *Aurinia uechtritziana*, *Erysimum quadrangulum*, *Verbascum purpureum*), a detailed GIS mapping was performed, as well as GPS topographic survey. The collected field data were further integrated and analyzed in a GIS environment using base maps and Digital Terrain Model (DTM). As a result of the study, detailed distribution maps of investigated species communities in Central Group were drawn. Special attention is paid to the zones where two or more communities are overlapped. Localization of these hotspots is crucial for protection management.

[Г8.2] Vergiev, S. 2019. GIS mapping of plant biodiversity hotspots in the Bulgarian floristic region Northern Black Sea Coast for 2018. SocioBrains, 54:196-201, ISSN 2367-5721.

The aim of the present study is to create a dynamic map of plant biodiversity hotspots in the Bulgarian floristic region Northern Black Sea Coast for 2018. The hotspots are defined as geographic areas with high species richness, especially endemic species, and that are threatened by habitat loss. Biodiversity hotspot models in GIS environment are an effective tool for vulnerability assessment, annual monitoring of status, distribution and conservation of plants, and for establishing long-term plant resource conservation strategies in regional scale. A GIS model, as well as a weighted value scheme for scoring each taxon, were used in order to identify, locate, and quantify the hotspots. The identified spots were categorized into five classes, based on a cumulative weighted value, and were indicated on the map using color scale.

[Г8.3] Vergiev, S. 2018. GIS mapping of plant biodiversity hotspots in the Bulgarian floristic region Black Sea Coast. SocioBrains, 52:171-178. ISSN 2367-5721

Hotspots are defined as geographic areas which are threatened by habitat loss and with high species richness, especially endemic species. GIS-based biodiversity hotspot models are an effective tool for vulnerability assessment, annual monitoring of status, distribution and conservation of plants, and for establishing long-term plant resource conservation strategies in regional scale. The aim of the present study is to create a dynamic map of plant biodiversity hotspots of the Bulgarian floristic region Black Sea Coast. A GIS model, as well as a weighted value scheme for scoring each taxon, were created in order to identify, locate, and quantify the hotspots. The identified areas were categorized into five classes, based on the cumulative weighted value scheme, and were indicated on the map using color scale. An attempt to refine the borders of the floristic region and sub-regions was made.

[Г8.4] Vergiev, S., Filipova-Marinova, M., Trifonova, E., Kotsev, I. 2019. Vulnerability assessment of coastal plant communities from flooding caused by unusual storms: A case study of Kabakum beach, Varna (Northeastern Bulgaria) for 2018 year. GSC Biological and Pharmaceutical Sciences, 2019, 09(03), 109–115. ISSN: 2581-3250

The present paper proposed a rapid method for vulnerability assessment of coastal plant communities from flooding caused by unusual storms over the Bulgarian Black Sea Coast. The model was tested and applied on Kabakum beach, Varna (Northeastern Bulgaria) for 2018 year. In order to create a dynamic GIS model, data from experimental results and detailed GIS mapping on the Kabakum beach (Varna) were incorporated. As a result of a simulated flooding experiment, Critical Decomposition Time (CDT) was obtained. Linking flood duration with CDT and altitudinal spreading of plants determines that *Artemisia vulgaris* L., *Eryngium maritimum* L. and *Crambe maritima* L. are vulnerable to storms. The plant communities in Kabakum beach are not threatened by complete destruction even during a storm with a return period of 100 years. Habitat recovery is likely within a season and does not require human intervention.

[Г8.5] Vergiev, S. 2018. The growth response of *Galilea mucronata* (L.) Parl. to sea water immersion. GSC Biological and Pharmaceutical Sciences, 5(2):103-108. ISSN: 2581-3250

Unusual storms along the Bulgarian Black Sea Coast may cause flooding, erosion and therefore destruction of plant communities of psammophytes which dominate sand dunes. In such cases *Galilea mucronata* (L.) Parl. occupies territories from dune pioneers and becomes a major dune stabilizer. This study aims to establish the viability of this species and possible negative consequences during simulated flooding experiments and thereby to investigate its capacity as dune stabilizer. Conducted experiments established that *G. mucronata* was very tolerant to immersion impact and salt stress. Whole plants stay viable longer than the flood with a maximum duration along the Bulgarian Black Sea Coast, and rhizomes were able to regenerate after 30 days in seawater. Statistical analysis of experimental data demonstrates that immersion in sea water increases rhizomes viability, biomass and allocation to root biomass, whereas other factors, such as duration of immersion and temperatures of sea water have no significant effect. *G. mucronata* was less tolerant to water immersion than other psammophytes, but demonstrated a high potential to be a key species for dune stabilization and could contribute to the protection of coastal sands during storms.

[Г8.6] Vergiev, S., Niyazi, D., Filipova-Marinova, M. 2017. GIS mapping of plant biodiversity hotspots in the Bulgarian floristic region Southern Black Sea coast. Proceedings of the 5th SSC "Ecology and environment", 21 April, Shumen, 47–55. ISSN 2367-5209

Hotspots are defined as geographic areas which are threatened by habitat loss and with high species richness, especially endemic species. GIS-based biodiversity hotspot models are an effective tool for vulnerability assessment, annual monitoring of status, distribution and conservation of plants, and for establishing long-term plant resource conservation strategies in regional scale. The aim of the present study is to create a dynamic map of plant biodiversity hotspots of the Bulgarian floristic region Southern Black Sea Coast. A GIS model, as well as a weighted value scheme for scoring each taxon, were created in order to identify, locate, and quantify the hotspots. The identified areas were categorized into five classes, based on the cumulative weighted value scheme, and were indicated on the map using colour scale. An attempt to refine the borders of the floristic sub-region was made.

[Г8.7] Vergiev, S. 2016. GIS mapping of plant biodiversity hotspots in the Bulgarian floristic region northern Black Sea coast. Proceedings of Fifth International Conference "Geographical Sciences and Education" 4-5 Nov, Shumen 163-166. ISBN 978-619-201-172-7

The aim of the present study is to create a map of plant biodiversity hotspots in the Bulgarian floristic region Northern Black Sea Coast. The hotspots are defined as geographic areas with high species richness, especially endemic species, and that are threatened by habitat loss. Biodiversity hotspot models in GIS environment are an effective tool for vulnerability assessment, annual monitoring of status, distribution and conservation of plants, and for establishing long-term plant resource conservation strategies in regional scale. A GIS model, as well as a weighted value scheme for scoring each taxon, were created in order to identify, locate, and quantify the hotspots. The identified spots were categorized into five classes, based on a cumulative weighted value, and were indicated on the map using color scale.

[Г8.8] Vergiev, S. 2016. Theoretical aspects of rapid GIS-based model for vulnerability assessment of medicinal plants in Bulgaria. Proceedings of Fifth International Conference "Geographical Sciences and Education" 4-5 Nov, Shumen 167–169. ISBN 978-619-201-172-7

The aim of the present report is to present and discuss some theoretical aspects of newly developing Rapid Model for Vulnerability Assessment of Medicinal Plants (RMVAMP). This model is created by adapting the method of Rapid Vulnerability Assessment (RVA) and is based on explicit criteria and on a weighted value scheme for scoring each taxon, rather than intuitive interpretation of experts in conventional assessments. Unlike RVA, which predicts vulnerability of plants to over-harvesting, RMVAMP assesses more aspects and critical factors which directly affect the target medicinal species. Cumulative weighted values are incorporated in GIS environment with base maps and Digital Elevation Models, as well as physical, climatic and geographical data. The territories are categorised into classes of vulnerability, and are indicated on the created maps using color scale.

[Г8.9] Vergiev, S., Filipova-Marinova, M. 2019. GIS-based model for analysis of modern pollen–climate relationship. Научни трудове на Съюза на учените в България–Пловдив, Серия В – Техника и технологии, 17:240-246. ISSN 1311-9419.

The aim of the present paper is to present a GIS-based model for analysis of modern pollen–climate relationship in order to obtain reliable modern pollen analogues for palaeoclimate reconstructions using the Modern Analog Technique (MAT). A data set consisting of 63 modern pollen surface samples from the basic plant communities along the North–South transect of the Bulgarian Black Sea Coast was created. Pollen percentage values were calculated on a sum of 43 pollen taxa for each pollen sample for 2018. Climatological data for each site, including average annual temperature, average temperature of the warm and cold half–year and average annual precipitation were taken from the nearest meteorological station and were corrected with an altitudinal coefficient of temperature variation. Statistical analysis was used to reveal the relationships between individual pollen types and climate variables.

[Г8.10] Vergiev, S., Plamenov, D., Naskova, P., Dimitrova, R. 2019. GIS-based model for analysis of modern pollen–vegetation relationship in agrocenoses. Научни трудове на Съюза на учените в България–Пловдив, Серия В – Техника и технологии, 17:247-252. ISSN 1311-9419.

The aim of the present paper is to present a GIS-based model for analysis of modern pollen–vegetation relationship in order to define the Relevant Source Area of Pollen (RSAP) for agrocenoses in northeastern Bulgaria. A dataset of pollen counts from 4 modern pollen samples together with corresponding vegetation data, measured around each sample point in concentric rings, were collected in 2018 yr. The plant abundance of each pollen type was weighed by distance in GIS environment in order to test and validate an adequate methodology for measurement of goodness-of-fit between pollen and vegetation data in agrocenoses and to create a calibrated model which can be used for quantitative interpretation of fossil pollen data in palaeoecological reconstructions. Three submodels of the ERV model are tested and show similar results but ERV 3 was selected and gives an RSAP of 4300 m for agricultural landscapes.

[Г8.11] Vergiev, S., Filipova-Marinova, M., Plamenov, D., Naskova, P., Dimitrova, R. 2019. GIS-based estimating pollen productivity of key plant taxa in agrocenoses and relevant source area of pollen in Eastern Bulgaria. SocioBrains, 54: 209-215, ISSN 2367-5721.

Pollen Productivity Estimate (PPE) is one of the main parameters that is used for quantitative interpretation of fossil pollen data in palaeoecological reconstructions. A dataset of pollen counts from 10 modern pollen samples in agrocenoses together with corresponding vegetation data, measured around each sample point in concentric rings, were collected in 2018 yr. Three submodels of the Extended R-Value (ERV) model are used to relate pollen percentages to vegetation composition. The plant abundance of each pollen type is weighed by distance in GIS environment in order to create a calibrated model. The aim of the present study is to calculate PPE of key plant taxa and to define the Relevant Source Area of Pollen (RSAP) in Eastern Bulgaria. Most of the tree taxa have PPE higher than 1 (ERV3 submodel). *Cichoriceae*, *Fabaceae* and *Asteraceae* have lower PPE.

[Г8.12] Vergiev, S., Filipova-Marinova, M. 2018. Estimating pollen productivity of key plant taxa and relevant source area of pollen in northeastern Bulgaria. SocioBrains, 52:162-170. ISSN 2367-5721

Pollen Productivity Estimate (PPE) is one of the main parameters that is used for quantitative interpretation of fossil pollen data in palaeoecological reconstructions. A dataset of pollen counts from 8 modern pollen samples in typical natural plant communities together with corresponding vegetation data, measured around each sample point in concentric rings, were collected in 2018 yr. Three submodels of the Extended R-Value (ERV) model are used to relate pollen percentages to vegetation composition. The plant abundance of each pollen type is weighed by distance in GIS environment in order to create a calibrated model. Poaceae (PPE = 1, with standard error = 0) is set as reference taxon. The aim of the present study is to calculate PPE of key plant taxa and to define the Relevant Source Area of Pollen (RSAP) in Northeastern Bulgaria. Most of the tree taxa have PPE higher than 1 (ERV3 submodel). *Cichoriceae*, *Fabaceae* and *Asteraceae* have lower PPE.

[Г8.13] Vergiev, S. 2019. GIS-based modern pollen–climate calibration set from Eastern Bulgaria for 2017. SocioBrains, 54: 202-208, ISSN 2367-5721.

A dataset consisting of 63 modern pollen surface samples from the basic plant communities along the North–South transect of the Bulgarian Black Sea Coast and typical agrocenoses was created in order to obtain reliable modern pollen analogues for palaeoclimate reconstructions using the Modern Analog Technique (MAT). Pollen percentage values were calculated on a sum of 43 pollen taxa for each pollen sample. Climatological data for each site, including average annual temperature, average temperature of the warm and cold half–year and average annual precipitation were taken from the nearest meteorological station and were corrected with an altitudinal coefficient of temperature variation. Statistical analysis was used to reveal the relationship between individual pollen types and climate variables in order to create a GIS-based modern calibrated climate-pollen dataset for 2017 year.

[Г8.14] Vergiev, S., Filipova-Marinova, M. 2016. Pollen productivity estimates of key plant taxa for palaeoecological quantitative reconstructions in Northeastern Bulgaria. Proceedings of the 4th SSC "Ecology and environment" 22-23 April, Shumen 96–107. ISSN 2367-5209

Pollen Productivity Estimate (PPE) is one of the main parameters that is used for quantitative interpretation of fossil pollen data in palaeoecological reconstructions. A dataset of pollen counts from 8 modern pollen samples together with corresponding vegetation data, measured around each sample point in concentric rings, were collected. Three submodels of the Extended R-Value (ERV) model are used to relate pollen percentages to vegetation composition. The plant abundance of each pollen type is weighed by distance in GIS environment in order to create a calibrated model. The reference taxon is Poaceae (PPE = 1, with standard error = 0). The aim of the present study is to calculate PPE of key plant taxa and to define the Relevant Source Area of Pollen (RSAP) in Northeastern Bulgaria. Most of the tree taxa have PPE higher than 1 (ERV3 submodel). Cichoriceae, Fabaceae and Asteraceae have lower PPE.

[Г8.15] Vergiev, S. 2020. Detailed GIS mapping of communities of plants with conservation status in Central Group of Protected area Pobiti Kamani (Northeastern Bulgaria) for 2018 year. SocioBrains, 65: 78-83, ISSN 2367-5721.

The aim of the present study is to investigate the distribution of communities of plant species with conservation status (rare, endemic, vulnerable, threatened, and protected) in Central Group (Northern and Southern zones) of protected area Pobiti Kamani (Stone Forest) for 2018 year. A detailed GPS mapping was performed for *Alyssum borzaeanum, Anthemis regis-borisii, Arenaria rigida, Centaurea arenaria, Dianthus nardiformis, Ephedra distachya, Aurinia uechtritziana, Erysimum quadrangulum,* and *Verbascum purpureum*. The collected field data were further integrated and analysed in GIS environment using base maps and Digital Terrain Model (DTM). As a result of the study, detailed distribution maps of the investigated species communities in Central Group were drawn. Special attention is paid to the zones where two or more communities were overlapped. Localization of these hotspots is crucial for protection management. The potential touristic routes and hiking trails were drawn on the basis of the concept of phytodiversity hotspots.

[Г8.16] Vergiev, S. 2020. GIS-based modern pollen-climate calibration set from the Kamchia River downstream region (Eastern Bulgaria) for 2019. SocioBrains, 74:105-110. ISSN 2367-5721

A dataset consisting of 30 modern pollen surface samples from the basic plant communities in the Kamchia River downstream region was created in order to obtain reliable modern pollen analogues for palaeoclimate reconstructions using the Modern Analog Technique (MAT). Pollen percentage values were calculated on a sum of 42 pollen taxa for each pollen sample. Climatological data for each site, including average annual temperature, average temperature of the warm and cold half–year and average annual precipitation were taken from the nearest meteorological station and were corrected with an altitudinal coefficient of temperature variation. Statistical analysis was used to reveal the relationship between individual pollen types and climate variables in order to create a GIS-based modern calibrated climate-pollen dataset for 2019 year.

[Г8.17] Vergiev, S. 2021. Detailed GIS mapping of communities of plants with conservation status and defining the touristic zones in the group "Kanarata and Quarry Drenaka" of the protected area "Pobiti Kamani" (Northeastern Bulgaria). GSC Biological and Pharmaceutical Sciences, 16(03):085-090. ISSN 2581-3250

The aims of the present study were: 1) to perform a detailed mapping of the distribution of conservationally significant (endemic, vulnerable, endangered and protected) plant species in the group "Kanarata and Quarry Drenaka" of the protected area "Pobiti Kamani" for 2020 yr in GIS environment; 2) based on the overlap of the distribution sites of plant species, to determine the "hot spots" of plant biodiversity, access to which should be limited in order to protect them and at the same time to identify areas with no or low concentration of conservationally important species in order to trace and mark the tourist paths in the protected area. In order to investigate the distribution of six plant communities, a detailed GIS mapping was performed. As a result of the study, detailed distribution maps of investigated species communities in Central Group were drawn. Special attention is paid to the zones where two or more communities were overlapped. The identification of the areas with concentration of conservation-significant species and localization of "hot spots" is crucial for protection management of the group "Kanarata and Quarry Drenaka" of the protected area "Pobiti Kamani". The model of "hot spots" and the model of overlapping are applicable and in combination with detailed distribution maps are fundamental for more successful protection and conservation. The suggested touristic zones with lack of conservation species can be used to trace and to construct environmentally friendly tourist trail and paths without destroying and harming the species, their habitats, and the aesthetic and recreational value of the landscapes.

[Г8.18] Vergiev, S. 2021. Identification, prioritization, and GIS mapping of plant biodiversity hotspots in the Bulgarian floristic region North-eastern Bulgaria. SocioBrains, 84:20-25. ISSN 2367-5721

Plant biodiversity hotspots are defined as geographic areas which are threatened by habitat loss and with high species richness, especially endemic species. Models for identification, prioritization, and GIS mapping are an effective tool for annual monitoring of status, distribution and conservation of plants, and for establishing long-term plant resource conservation strategies in regional scale. The aim of the present study is to create a dynamic map of plant biodiversity hotspots of the Bulgarian floristic region North-Eastern Bulgaria. A GIS model, as well as a weighted value scheme for scoring each taxon, were created in order to identify and to prioritize the hotspots. Forty-eight areas were identified and were categorized into five classes, based on the cumulative weighted value scheme, and were indicated on the map using color scale. An attempt to refine the borders of the floristic region was made.

[Г8.19] Vergiev, S. 2021. Sea water flood resilience of five plant species with conservation status over the Bulgarian Black Sea Coast. GSC Biological and Pharmaceutical Sciences, 16(03):019-023. ISSN 2367-5721

The Bulgarian Black Sea coastal zone is relatively protected from sea floods. Only extreme meteorological events such as unusual storms can cause flooding of coastal areas. Crucial for the application of rapid methods for vulnerability assessment of coastal plant communities from flooding caused by unusual storms over the Bulgarian Black Sea Coast is to obtain experimental data for sea water flood resilience. This study aims to determine the plant species survival in simulated flooding experiments in order to identify sea water flood resilience of five plant species with conservation status: *Centaurea arenaria* M. Bieb. ex Willd., *Crambe tataria* Sebeok, *Aurinia uechtritziana* (Bornm.) Cullen & Dudley, *Silene thymifolia* Sm., and *Stachys maritima* Gouan. As a result of a simulated flooding experiment, Critical Decomposition Time (CDT) was obtained. The five species were within the most vulnerable group (CDT < 48 h). The CDT was significantly shorter than floods with a maximum duration for the Bulgarian Black Sea Coast. Only the values of the parameter beginning of decomposition of the leaves were accelerated by higher water temperatures. Other parameters were unrelated to different water temperatures. The investigated species have low survival rates and low degree of sea water flood resilience and their communities will not be able to recover after flooding with maximum duration within one vegetation season.

[Г8.20] Vergiev, S. 2021. Modern pollen-climate calibration set from the Balkan Mountains Region (Bulgaria) for 2020. SocioBrains, 83:92-98. ISSN 2367-5721

A dataset consisting of 20 modern pollen surface samples from the basic plant communities in the Balkan Mountains region was created in order to obtain reliable modern pollen analogues for palaeoclimate reconstructions using the Modern Analog Technique (MAT). Pollen percentage values were calculated on a sum of 41 pollen taxa for each pollen sample. Climatological data for each site, including average annual temperature, average temperature of the warm and cold half–year and average annual precipitation were taken from the nearest meteorological station and were corrected with an altitudinal coefficient of temperature variation. Statistical analysis was used to reveal the relationship between individual pollen types and climate variables in order to create a modern calibrated climate-pollen dataset for 2020 year.

[Г8.21] Vergiev, S., Filipova-Marinova, M., Toneva, D., Stankova, T., Dimova, D., Lesidrenski, K. 2021. Key parameters for landscape evolution and anthropogenisation estimation in the Kamchia River downstream region (Eastern Bulgaria). Annual journal of Technical University of Varna, Bulgaria, 5(1):86-93. ISSN 2603-316X

Pollen productivity estimate (PPE) and relevant source area of pollen (RSAP) are critical parameters for quantitative interpretations of pollen data in palaeolandscape and palaeoecological reconstructions, and for analyses of the landscapes evolution and anthropogenisation as well. In light of this, the present paper endeavours to calculate PPE of key plant taxa and to define the RSAP in the Kamchia River Downstream Region (Eastern Bulgaria) in order to use them in landscape simulations and estimations. For the purposes of this research, a dataset of pollen counts from 10 modern pollen samples together with corresponding vegetation data, measured around each sample point in concentric rings, were collected in 2020. Three submodels of the Extended R-Value (ERV) model were used to relate pollen percentages to vegetation composition. Therewith, in order to create a calibrated model, the plant abundance of each pollen type was weighed by distance in GIS environment. The findings led to the conclusion that most of the tree taxa have PPE higher than 1 (ERV3 submodel). *Cichoriceae*, *Fabaceae* and *Asteraceae* have lower PPE.

[Г8.22] Vergiev, S.,. 2021. Pollen productivity estimates of key plant taxa in the Balkan Mountains Region. SocioBrains, 84:26-32. ISSN 2367-5721

Pollen Productivity Estimate (PPE) is crucial parameters that is used for quantitative interpretation of fossil pollen data in palaeoecological and palaeolandscape reconstructions. A dataset of pollen spectra from 20 modern pollen samples together with corresponding vegetation data, measured around each sample point in concentric rings, were collected in 2020 yr. Three submodels of the Extended R-Value (ERV) model were used to relate pollen production to vegetation composition. The plant abundance of each pollen type is weighed by distance in GIS environment in order to create a calibrated model. Poaceae is set as reference taxon with PPE = 1 and standard error = 0. The aim of the present study is to calculate PPE of 30 key plant taxa in Balkan Mountains region. Most of the tree taxa have PPE higher than 1 (ERV3 submodel). *Aster*-type, *Fabaceae*, and *Cichoriceae* had lower PPE.