The physico-geographical particularities of the "Vila Nisporeni" Emerald site as support in the development of its sustainable management plan

Les physico-géographiques particularités du site Émeraude « Vila Nisporeni» comme soutien à l'élaboration de plan de gestion durable

Ala DONICA[1]*, Viorica ANGHELUȚA[2], Iradion JECHIU[2], Aliona BOTNARI[2], Tatiana BUNDUC[2]

[1] "Natural and anthropogenic ecosystems" laboratory, Institute of Ecology ang Geography of Moldova State University, the Republic of Moldova
[2] "Geography" laboratory, Institute of Ecology ang Geography of Moldova State University, the Republic of Moldova

* Correspondence to: Ala DONICA. E-mail: aladonica1980@gmail.com.

Vol. 36.1 / 2026, 141-162

GEOREVIEW

Received:
17 April 2025

Accepted:
15 December 2025

Published online:
19 December 2025

ABSTRACT: The Emerald Network plays a crucial role in biodiversity conservation, extending the principles of the Natura 2000 framework to non-EU countries and contributing to the long-term protection of natural habitats and biodiversity. The physico-geographical vulnerabilities of the "Vila Nisporeni" Emerald site result from the complex interaction of the region's geological, geomorphological, climatic, hydrological, pedological and landscape characteristics, each contributing in different ways to the high sensitivity of its natural ecosystems. In addition, presure and threats on natural stands, dominated by oak, which support a unique assemblage of species, including the only wild population of *Paeonia peregrina* Mill., in the Republic of Moldova, impose establishment of appropriate measures in the Management Plan. In the Management Plan of this site, in addition to the specific measures for the protection of biodiversity, conservation of habitats and emblematic species, improvement of the habitats condition, adequate management, periodic monitoring, according to well-established indicators; measures for education, information and awareness of local communities will also be established (with an emphasis on local natural heritage).
KEY WORDS: "Vila Nisporeni" Emerald site, environmental factors, physical and geographical particularities, valuable habitats, rare species.

RÉSUMÉ: Le Réseau Émeraude joue un rôle crucial dans la conservation de la biodiversité, en étendant les principes du réseau Natura 2000 aux pays non membres de l'UE et en contribuant à la protection à long terme des habitats naturels et de la biodiversité. La vulnérabilité physico-géographique du «Vila Nisporeni» Émeraude site résulte de l'interaction complexe des caractéristiques géologiques, géomorphologiques, climatiques, hydrologiques, pédologiques et paysagères de la région, chacune contribuant différemment à la grande sensibilité de ses écosystèmes naturels. De plus, les pressions et les menaces qui pèsent sur les peuplements naturels, dominés par le chêne et abritant un ensemble unique d'espèces, dont la seule population sauvage de *Paeonia peregrina* Mill. en République de Moldavie, imposent la mise en place de mesures appropriées dans le plan de gestion. Dans le plan de gestion de ce site, outre les mesures spécifiques de protection de la biodiversité, de conservation des habitats et des espèces emblématiques, d'amélioration de l'état des habitats, de gestion adéquate et de suivi périodique selon des indicateurs bien établis, des mesures d'éducation, d'information et de sensibilisation des communautés locales seront également mises en place (avec un accent particulier sur le patrimoine naturel local).

MOTS CLÉS: «Vila Nisporeni» Site Émeraude, facteurs environnementaux, particularités physiques et géographiques, habitats précieux, espèces rares.

How to cite this article:
Donica, A., Angheluța, V., Jechiu, I., Botnari, A., Bunduc, T. (2025) The physico-geographical particularities of the "Vila Nisporeni" Emerald site as support in the development of its sustainable management plan. Georeview, 36, 1, https://doi.org/10.4316/GEOREVIEW.2026.01.10

1. Introduction

The Emerald Network presents a network of protected areas focused on ensuring the species and habitats long-term survival, which was established under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern, 1979). In Law No. 94/2007 on the ecological network, the notion of the “Emerald Network” is defined as “an ecological network consisting of special areas of conservation, part of the national ecological network, representing the extension to non-EU countries of the coherent European ecological network of special areas of conservation-Natura 2000”. At the same time, Law No. 162/2017 amending and supplementing certain legislative acts (in order to transpose Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora), defines the notion of “area of special interest for conservation” as "site of common European importance in which the necessary conservation measures are provided for the maintenance or restoration to a favourable conservation status of the natural habitats and/or populations of the species for which the site is designated".

The Emerald sites in the Republic of Moldova, formed predominantly on protected territories (natural areas protected at national level, by Law No. 1538 of 25-02-1998 on the fund of state-protected natural areas) shelter ecosystems with significant concentrations of biodiversity at global, regional or national level and provide refuge for various rare, threatened, endangered species (EU4Environment, 2023). Rare species are protectec through their inclusion in Annex 3 of the Law No.1538/1998 and in the Red Book of the Republic of Moldova (2015). At the same time, the Emerald sites present favorable conditions for the conservation of birds – the so-called Important Bird and Biodiversity Areas (BirdLife, 2025).

Current environmental changes have a direct impact on protected areas, influencing the ecosystems existence conditions. Anthropogenic activities manifested by deforestation, agricultural expansion, road construction, hunting, climate change, etc., significantly contribute to the loss of biodiversity, especially by reducing natural habitats and growing their fragmentation. The increased vulnerability of forest habitats, steppe and stony habitats, to the regional climatic conditions is the result of low functionality caused by fragmentation and degradation (Lozan et al., 2019, Gunawan et al., 2024).

Based on the Emerald sites importance for biodiversity conservation, the Environmental Strategy of the Republic of Moldova (2024-2030) establishes the need to strengthen measures in protection of natural ecosystems and ensuring its sustainable management. Thus, the protection, restoration and promotion of biodiversity sustainable use and natural ecosystems could be achieved through the development of the national ecological network, reducing the fragmentation of natural ecosystems and the creation of connecting ecological corridors; expanding the state-protected natural areas to 10.0% of the national territory; developing sustainable management plans for protected natural areas and the national ecological network core areas; expanding the Emerald Network sites; as well as advancing the Emerald Network sites management.

2. Study area

The study is carried out within the project: 010801 “Increasing the ecological security and resilience of geo-ecosystems to current environmental changes”; subprogram: “Development of management plans of Emerald sites in the Republic of Moldova”, funded by the National Agency for Research and Development, the Republic of Moldova. For the 2025 research included "Integrated assessment of the environmental factors ecological status in the territory of the

Emerald site: MD00000028 "Vila Nisporeni", with the estimation of the impact and risk that threatens their integrity and the development of its Management Plan".

The "Vila Nisporeni" EMERALD site presents an Special Area of Conservation for habitats and rare species, being located in the western part of the Republic of Moldova, delimited by a series of localities, such as the Nisporeni city, the villages of Iurceni, Cristești, Bolțun, Cornești, Pașcani, Boghiceni, Chetroșeni, Odaia, etc. The boundaries of the "Vila Nisporeni" Emerald site correspond to those on the official website of the European Environment Agency (Fig. 1).

3. Methods

In the evaluation of the physical-geographical particularities of the "Vila Nisporeni" Emerald site, a series of thematic maps were analyzed (geological and pedological data from the geological and pedological maps with a scale of 1:200 000, relief analysis from the the 30-Meter SRTM- DEM, the names of valleys and hills from the topographic map with a scale of 1:50 000, hydrographic network from the 2020 orthophoto maps).

According to official data (Emerald – Standard Data Form), site area covers 5451.0 ha, with habitats from continental biogeographical region and more than 20 rare species (Tab. 1).

Table 1 Data about the Emerald site "Vila Nisporeni".

Site Code	Site Name Area (ha)	Site location (geographical coordinates of the extreme points)	Species protected under the Bern Convention (1979)	Habitats, units	Biogeographical region
MD00000028	Vila Nisporeni 5451,0	North - 28°12' Lat. N 47°5' Long. E South - 28°18' Lat. N 46°57' Long. E West - 28°10' Lat. N 47°2' Long. E East - 28°21' Lat. N 46°58' Long. E	20	2	continental

The physical-geographical and biogeographical features description of the Emerald site was carried out according to the indications of the "Guide on Biodiversity Assessment", approved by Order of the Ministry of Environment No. 105/2024, but, also, the indications of the "Guide on the development of management plans for Emerald sites in the Republic of Moldova" (EU4Environment, 2024).

The data on climatic parameters (annual thermal regime and annual precipitation amount, period 1980-2024) were collected by the authors from the State Hydrometeorological Service.

In the study, the primary analysis of statistical data was carried out using traditional methods, in Excel, and subsequently GIS tools and techniques were used, necessary for map modeling and spatial analysis. Based on the MNT, relevant thematic maps were generated, and geomorphological, geological and pedological data vave been integrated and processed in ArcMap 10.8 (GIS Tutorial for ArcGIS Desktop 10.8, 2020).

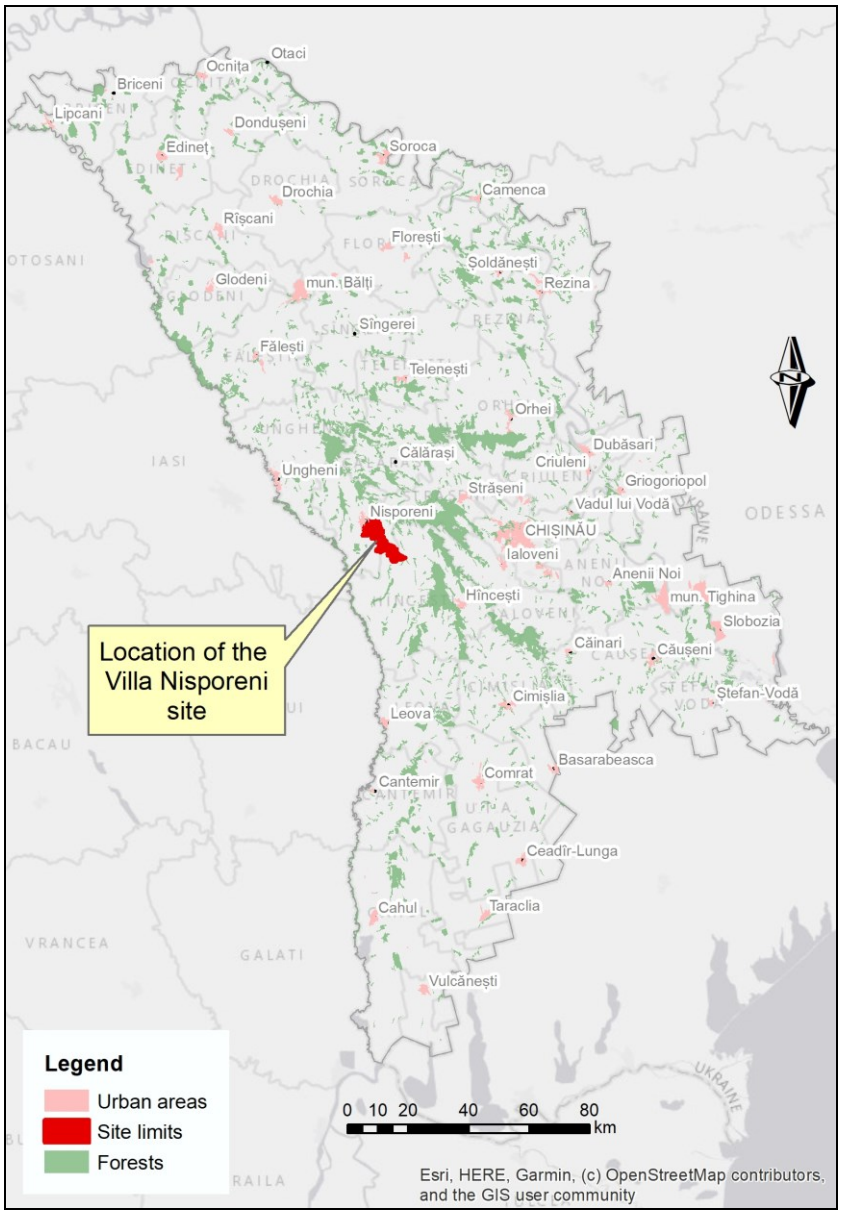

Figure 1 Boundaries of the "Vila Nisporeni" Emerald site (according to the European Environment Agency https://emerald.eea.europa.eu/).

The Emerald Network (to which the Republic of Moldova is a party) does not have a formal classification for “pressures and threats” as a category, but uses a detailed reference list of pressures and threats to monitor and manage its sites, close to IUCN classification of presure and threats (2024). This list is used in the Standard Data Form to record factors such as agriculture, forestry and pollution that affect the conservation status of species and habitats, and the intensity of these impacts is classified as high, medium or low. However, as the Emerald Network presents the extension of the Natura 2000 network of protected areas to non-EU countries, the standardised code system (Natura 2000) is often used to classify pressures and threats to protected sites. These classifications help EU Member States identify, monitor and manage threats

to ensure the long-term sustainability of habitats and species (Reference list Threats. Pressures codes 2019-2024).

4. Results and discussion

4.1. Geology

From a geological point of view, the territory of the “Vila Nisporeni” Emerald site lies on the Moldavian Platform, whose basement is composed predominantly of metamorphic rocks, followed by magmatic rocks, most likely of intrusive origin. These formations are characteristic of the platform crystalline basement and are not exposed at the surface within the study area.

The sedimentary cover is made up of marine sedimentary deposits, belonging to the Sarmatian-Meotian interval. The oldest geological deposits belong to the Sarmatian stage (the Bessarabian substage), occurring on the degraded slopes of the Nârnova, Lăpușna, Șișcanilor and Bujoru valleys. The thickness of the Bessarabian deposits reaches about 170 m and is represented by light-gray marls with intercalations of carbonate clays, siltstones and quartzite sands (Fig. 2).

The most widespread geological deposits belong to the Chersonian – Meotian stage and are mainly composed of terrigenous deposits. A lower horizon is identified, represented by a package of greenish-gray clays (≈ 90 m) with intercalations of siltstones and microgranular quartzite sands of the fore-delta and which contains rare and thin intercalations of marine mollusk shells, and rarely - freshwater mollusk shells (Spian, 2023).

On the elongated peaks, with altitudes exceeding 300 m, Pliocene deposits appear (Kimmerian and Akchagylian sublevels), characterized by terrace alluvium – sands and pebbles with Carpathian jasper, siltstones and alluvial clays (Butkaciuc, 1968).

The Quaternary is characterized by the presence of eluvial deposits (located on the interfluvial peaks and plateaus) and deluvial deposits (located on the steep slopes of the valleys).

Thus, understanding the complex geological framework of the “Vila Nisporeni” Emerald site, from its crystalline basement to the sedimentary and Quaternary deposits, is essential for informing sustainable management strategies, which account for erosion risks, soil stability, and the long-term preservation of the site’s ecosystems.

4.2. Relief

The geomorphological framework of the studied region reflects a hilly relief, specific to the Codrilor Plateau (Fig.3). The highly fragmented plateau relief resulted from the interaction of endogenous and exogenous processes. Against the background of new tectonic movements in the Neogene-Pleistocene, a system of exogenous processes developed extensively. Among these, erosional and gravitational processes played a particularly important role in shaping the current relief.

In addition, the structural characteristics of the underlying sedimentary formations significantly influence the morphology of slopes and the development of specific geomorphological processes. In the Moldavian Plateau, such structural control often manifests as cuesta relief, where differences in lithological resistance and bedding orientation guide the evolution of slopes and sculpted landforms.

In the study area, the “Vila Nisporeni” Emerald site is entirely situated within the Western Codrilor Plateau geomorphological subunit (Boboc, 2019), on the western branch of the Milești-Boghiceni interfluvial ridge, a long interfluvial ridge with the highest altitudes in the Republic of Moldova, frequently exceeding 300 m (Fig. 3). Here, the orientation and composition of sedimentary layers

contribute to the slopes' morphological differentiation and control the intensity and type of erosional processes.

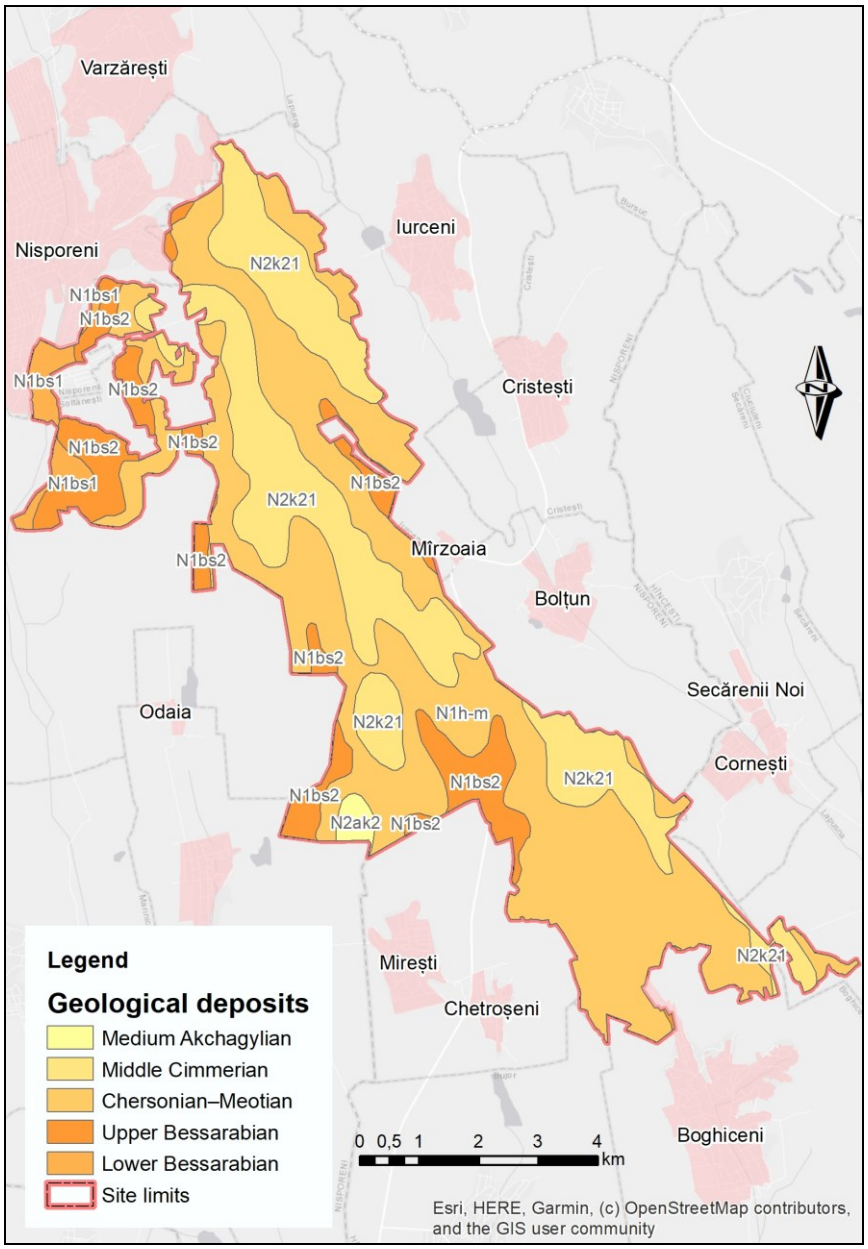

Figure 2 Geological deposits of the "Vila Nisporeni" Emerald site (processing according to the Geological Map, scale 1:200000).

The hypsometry of the study area is characterized by an alternation of higher hills and lower-lying meadows along the watercourses. The highest point within the site reaches 382.7 m at Corboaia Hill in the northern part. Moving southwards, the terrain gradually descends, with several notable elevations above 300 m within the site, including Hl. Mârzoaia (316.5 m), Hl. Verdișoaia (357.1 m), Hl. Movila Observatorul (334.4 m), and Hl. Holmu (285 m). The lowest areas are found along the meadows of the watercourses, tributaries of the Nârnova River.

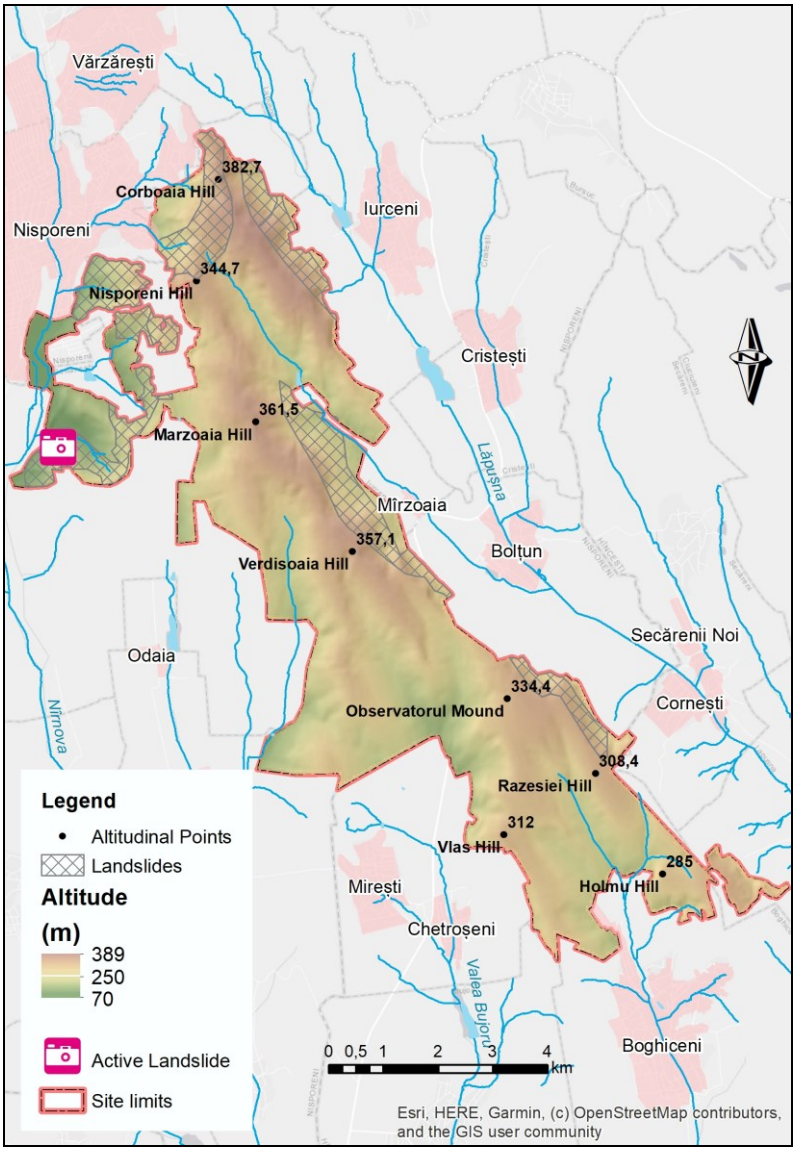

Figure 3 Hypsometric map of the "Vila Nisporeni" Emerald site (processing according to the 30-Meter SRTM- DEM).

Being located on an interfluve ridge, the eastern part of the Emerald site is distinguished by slopes with higher inclination, compared to the slopes with western exposure. Respectively, the slopes with northern and northeastern exposure are predominantly characterized by tilt of up to 30^0, conditioning an intensification of the current geomorphological processes. Slopes with values between 0^0 and 3^0 are characteristic of sculptural peaks and meadows, and those above 3^0 are characteristic of slopes.

The current geomorphological processes indicate, on the one hand, the direction and intensity of the relief evolution, constituting natural degradations of the geographical environment, especially of the soil, and on the other hand, they can constitute geomorphological risk factors. Therefore, in the studied area, the main degradation processes are represented by landslides, occupying over 20% of the total Emerald site surface. The most affected areas are located in the north-west and west of the site (Fig. 4).

Therefore, understanding the relief and geomorphological dynamics of the „Vila Nisporeni" Emerald site, including slope variations, hypsometry, and active processes such as landslides, is crucial for developing a sustainable management plan that addresses erosion and terrain stability while supporting the conservation of the site's natural ecosystems.

Figure 4 Active landslide in the "Vila Nisporeni" Emerald site (photo by author). The location of this landslide is indicated in Figure 3.

4.3. Climatic characterization

The climate of the study region is conditioned by the complex interaction of the primary climatogenic factor - solar radiation with the large scale atmospheric circulation patterns and the terrain physical properties (Mihăilă, 2002). The climate parameters put their mark on the local environmental conditions, which form the basis for the ecological functioning of the "Vila Nisporeni" Emerald site and provides a scientifically grounded foundation for the development of a sustinable management plan. Thus, the site relief imposes a certain way of climatic phenomena manifestation and the natural vegetation - represented largely by arborescent vegetation - has a moderating role in the climatic elements variation (Mihăilă, 2006).

Data from the specialized literature (Nedealcov, 2020) indicate that in evolutionary terms, the average annual temperature on the Republic of Moldova territory has been recording obvious increases since 1990, the last decades attesting to upward trends for this climatic parameter.

For the "Vila Nisporeni" Emerald site, the average monthly air temperature oscillates around the values of 10°C and 11°C, from the north to the south of the site territory and decreases from the lowlands to the highlands of the site.

The minimum annual value is recorded in January, due to the predominance of the anticyclonic regime and the development, for this reason, of temperature inversions. Thus, in January, the temperature varies within the minus 2.5°C and minus 1.5°C values. By comparison, the difference between the average annual temperature, indicated by the data series analyzed for the last 30 years (1990-2020) and the values indicated in the specialized literature (Atlas, 1978), for the study region, highlights a warming of approximately 1°C.

The July month for the study region records average temperatures between 21.5°C and 23.5°C, values higher by over 1°C compared to the data presented in the same Atlas (1978), possible due to the fact that in the last 10 years, thermal records have been set, with values exceeding 35°C.

In the transitional seasons (spring, autumn), the average temperatures are generally between 10°C and 10.5°C. The thermal differences of over 10°C between summer and winter emphasize the climate excessive continental character.

In the studied region, gradual and consistent increase in the annual mean temperature (from 1990 to 2024) is attested (Fig. 5). Although year to year fluctuations are evident, the overall trend is clearly upward, as confirmed by the trend line and the R^2 value of 0.54, indicating a moderate correlation between time and warming temperatures.

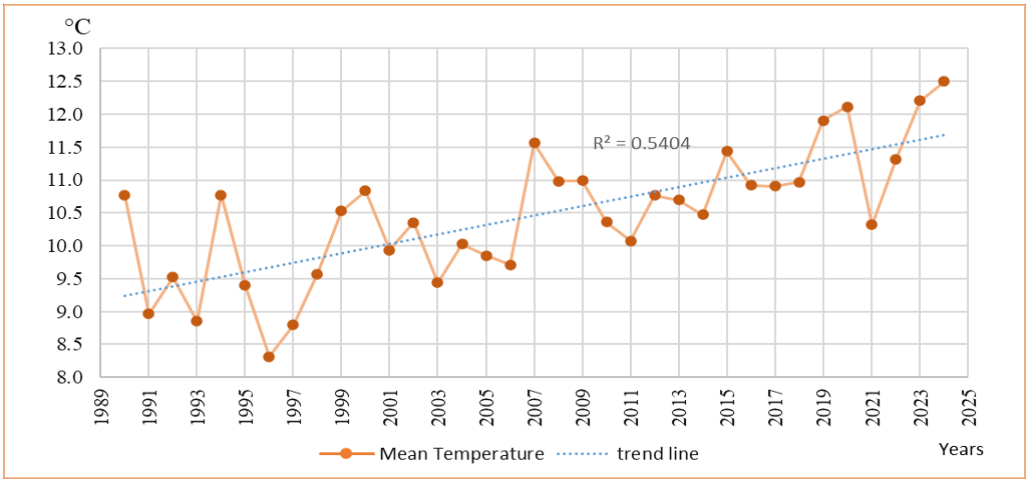

Figure 5 Temporal variation of Annual Mean Temperature with Trend Line (1989 - 2024), Nisporeni meteorological station (based on the State Hydrometeorological Service data).

Over the past two decades, high temperature years have become more frequent, with the 2022-2024 period recording the warmest values in the entire dataset, suggesting an intensification of regional warming.

Rainfall, for the study area, changes its quantities from one season to another due to the atmosphere general dynamics, to which are added local factors, whiw influence on the quantity, duration, intensity and frequency of precipitation.

The data analysis from the Nisporeni meteorological station and from the recent maps (Atlas, 2023), indicate for the study Emerald site, an average amount of over 650 mm of precipitation for territorie covered by forest ecosystems, at altitudes exceeding 250 m, and smaller amounts of precipitation - about 500-550 mm - recorded in river meadows.

In 1991, 2016, 2021, 2024 year, over 700 mm of average annual precipitation were recorded (Fig. 6).

For the period 1980 - 2024, the average amount of precipitation was about 540 mm. It is noted that the general trend of the average annual amount of precipitation in the region corresponds to the forecasts made at the national level (Atlas, 2021), where it is indicated that the spatial distribution of the annual amount of precipitation in the RCP 4.5 climate scenario (considered a moderate scenario), for the period 2016-2035, in the central part of the Republic of Moldova, at altitudes, could be 750-800 mm (compared to 700 mm and less in the reference period 1986-2005).

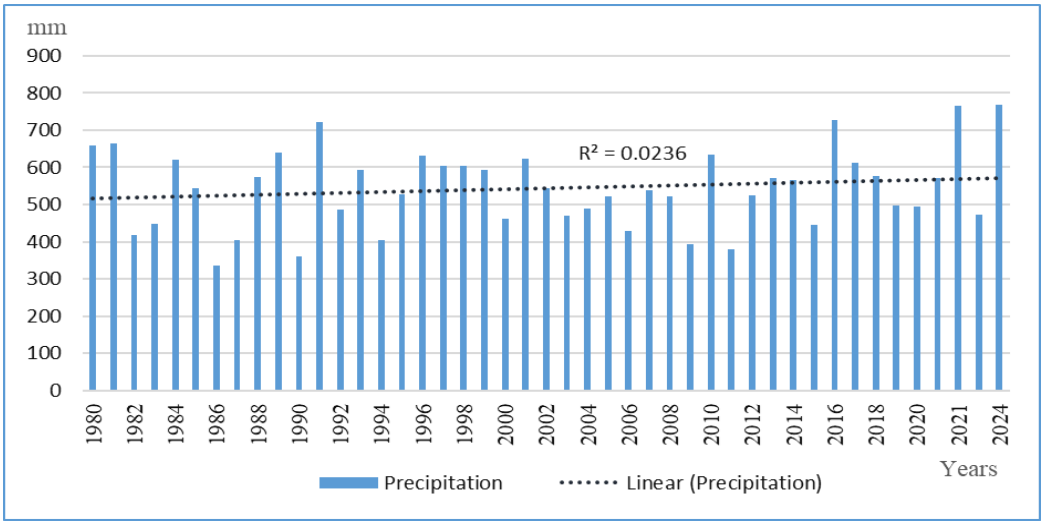

Figure 6. Temporal variation of Annual Mean Precipitation with Trend Line (1980-2024), Nisporeni meteorological station (based on the State Hydrometeorological Service data).

The climatic data, assessed for the 1980-2024 period (Fig. 5, Fig. 6) reveal a clear long-term warming trend, supported by a steady increase in the mean annual temperature and a comparatively high coefficient of determination. This pattern indicates an intensification of radiative processes and shifts in the local thermal dynamics of the atmosphere, suggesting a gradual reconfiguration of the regional climate regime. At the same times, although annual precipitation amounts exhibit considerable interannual variability, their overall trend is slightly positive. This, subtle, hydrological signal may represent a response to rising temperatures, driven by enhanced evapotranspiration and by the atmosferic humidity.

Taken together, the two climatic components - temperature and precipitation, indicate that the "Vila Nisporeni" Emerald Site is undergoing a climatic adjustment, in wich warming may indirectly influence the hidrological regime. These changes have the potential to produce ecological effects, including shift in species dynamics and phenology, variations in soil moisture, and alterations in the habitats stability, which are sensitive to hidric conditions. Therefor, the identified trends (Fig. 5, 6) represent critical elements to be incorporated into the site's sustainable management plan. Adapting to these climatic development, trough continous monitoring, ecological risk assesment, and the implementation of adaptive conservation measures is essential for maintaining the ecological functionality and natural values of the protected area.

4.4. Hydrographic resources

Due to its geographical position and characteristics, the hydrographic network of the "Vila Nisporeni" Emerald site is integrated into two sub-basins: Lăpușna and Nârnova, both belonging to the Prut-Danube-Black Sea hydrographic district. The main collector, around which the entire hydrographic network is organized, is the Prut River.

The surface waters of the "Vila Nisporeni" Emerald site are divided into two categories: flowing waters and stagnant waters. The hydrographic network is made up of rivers and streams, whether permanent or temporary, which together create a dynamic and varied landscape, and has a total length of 17.13 km, made up of 16 river segments (www.geodata.gov.md). This includes varying lengths portions of the upper courses of the Lăpușna and Nârnova rivers tributaries (as is shown in Fig. 3). In the site' southern part there are several sectors of the Călmățui river upper course, with lengths ranging between 1.1 and 2.1 km (Bejenaru, 2018).

The hydrographic network density is uneven; thus, within the "Vila Nisporeni" Emerald site the hydrographic density average value is 0.32 km/km2, lower than the country average value (0.48 km/km2). The territory of the Emerald site has a low provision of standing waters, being characterized by the presence of a single main water accumulation (artificial lake) of anthropogenic origin. This was created both for economic needs, such as fishing, irrigation and recreation, and for regulating the Lăpușna River flow, mitigating the risk of floods. Its total area is 1.9 ha, representing approximately 0.03% of the study area. In addition, in the analyzed perimeter there are two small sectors, corresponding to two other anthropogenic lakes, with areas of 0.06 ha and 0.14 ha, *which confirms the deficit of aquatic resources in this region*.

Groundwater resources complement the surface water network. The site is underlain by aquifers associated with the Moldavian Plateau sedimentary formations. Shallow aquifers are generally found a few meters below the surface and provide fresh water, suitable for domestic use, irrigation, and livestock. Deeper aquifers may contain higher mineralization levels, though the water remains, generally, usable for local needs. The groundwater volume is moderate, with recharge closely linked to precipitation, infiltration from rivers, and meadow soils. Quality is relatively good, but local anthropogenic activities could impact it, particularly near settlements and agricultural areas. Overall, groundwater represents an important supplementary resource in an area with limited surface water availability.

The detailed understanding of the site's surface and groundwater resources highlights the importance of water in maintaining ecological balance and provides a solid foundation for a sustainable management plan of the "Vila Nisporeni" Emerald site.

4.5. Vegetation cover

According to the Moldova geobotanical regionalization (Postolache, 2015), the "Vila Nisporeni" Emerald site is located at the contact of 2 geobotanical regions:

1. The region of mesophilous and submesophilous deciduous forests on the Codrilor Plateau; namely, the subregion with mesophilous forests, predominated by sessile oak, pedunculate oak with hornbeam from the Codrilor Plateau;

2. The region of thermophilic sub-Mediterranean forests, from the forest-steppe region, with pedunculated oak - mesophilic species and downy oak - xerophytic species, as edifyings trees.

A significant part of the Emerald site (3499 ha), comprising the "Vila Nisporeni" Landscape Reserve, located southeast of the Nisporeni city, foolowed by the Geological and Paleontological Natural Monument "Hârtopul de lângă orașul Nisporeni" (200 ha), located 6 km south of the Nisporeni city, on the Nârnova River left bank (Fig. 7).

The protected area - "Vila Nisporeni" Landscape Reserve represents a forest area with fundamentally natural stands of sessile oak (916 ha), downy oak (576 ha) and less with pedunculate oak stands (80.5 ha). According to data (Postolache et al., 2018), this Reserve includes the following valuable habitats:

A) Danubian mixed forests of pedunculate oak;

B) Geto-Dacian forests of sessile oak (*Quercus petraea*) with *Dentaria bulbifera*; of pedunculate oak (*Quercus robur*) and lime (*Tilia tomentosa*) with *Scutellaria altissima*;

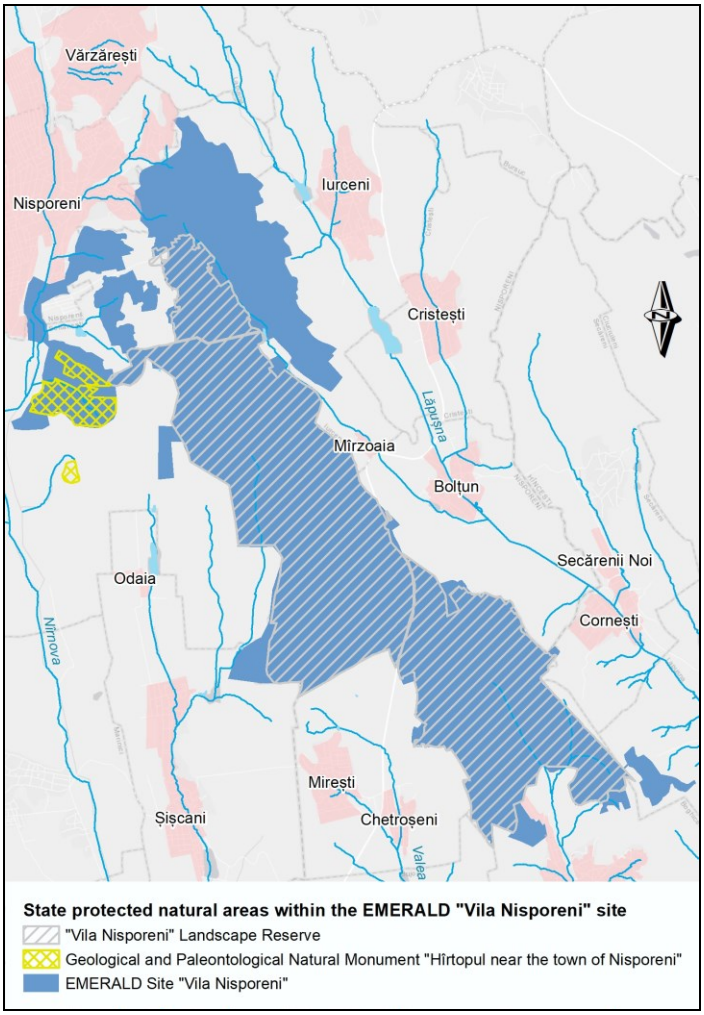

Figure 7 Schematic representation of the state-protected natural areas within the perimeter of the Emerald site "Vila Nisporeni" (the Institute of Ecology and Geography' basedata).

C) Dacian forests of downy oak (*Quercus pubescens*) with *Lithospermium purpurocaeruleum*;

D) West Pontic mixed forests of sessile oak with silver lime (*T.tormentosa*) and hornbeam (*Carpinus betulus*).

Studies on the downy oak (*Quercus pubescens*) stands within the Reserve have indicated that they occupy about 12.4% of the total area, *but have a richer biodiversity than the other stands of the Reserve* (Mârza et al., 2019). Within the downy oak forests, 5 associations was registered:

- the *Brachipodium pinnati-Quercetum pubescentis* association, represents the phytocenoses located under the canopy of the downy oak forest. It is formed by fundamental, subproductive natural stands. The arborescent layer is formed by thickets accompanied by clearings. The shrub layer, found in bunches, is made up of *Cornus mas, Swida australis, Rosa sp., Crataegus curvisepala, Prunus spinosa*, etc., the herbaceous cover being rich;

- the association *Quercetum pubescentis* (Soo 1931) Emend Jakues et Fekete 1958, includes the middle part of the slopes with southwest exposure. The distribution of phytocenoses is uniform, without clearings. In the arboreal layer, *Quercus pubescens* predominates, and in the shrub layer -

Cotinus coggygria. Unfortunately, through inadequate silvotechnical works on the fundamental natural stands, the autochthonous species and biodiversity are threatened;

- *Paeonio peregrinae - Quercetum pubescentis* (Sârbu 1982) Popescu et Sanda, 1999. The characteristic species of this association is the forest peony (*Paeonia peregrinae* Mill.), which is found sporadically, the population of this species being in obvious decline under the impact of the anthropogenic factor. The forest peony is a critically endangered species, protected in this Reserve since the year it was founded (1975). On an area of about 3 ha, the only population of wild peony in the country grows;

- the relict communities of *Chrysopogon grillus* (L.) are characteristic of the plant association *Cotino-Quercetum pubescentis Chrysopogonetosum*;

- *Cotino-Quercetum pubescentis Festucosum valesiacae*.

The importance of local habitats for *Paeonia peregrinae* Mill., was indicated, also, in another study (Pinzaru et al., 2016). The peony has been found in Boltun village, Nisporeni district, being included in all editios of the Red Book of the Republic of Moldova (1978, 2001, 2015, category: Critically Endangered [CR]). Populations of *Paeonia peregrina*, in Moldova, are found at the eastern part of the studied area. Uprooting of plants, grazing and mowing in glades and forest edges are limiting factors for this species. The association *Paeonio peregrinae-Quercetum pubescentis* (Sârbu 1982) Popescu et Sanda 1999 was proposed to be included in the alliance *Quercion pubescenti-petraeae* Br.Bl. 1932, ord. *Quercetalia pubescenti-petraeae* Klika 1933, cl. *QUERCO-FAGETEA* Br.-Bl. et Vlieger in Vlieger 1937.

According to the official information in the Standard Data Form of the “Vila Nisporeni” Emerald site the following natural habitats are found on its territory:

- G1.22. mixed riparian forests of *Quercus - Ulmus - Fraxinus*. Riparian forests in the middle reaches of large rivers are flooded only in case of high floods;

- G1.A4. Forests located on slopes and ravines. They are represented by humid forests, with the dominance of the species *Acer spp., Tilia spp., Fraxinus spp.*, on more or less steep slopes.

But, the recent studies (Miron et al., 2025) indicates that habitats, previously reported in the Standard Data Form of the "Vila Nisporeni" Emerald site *were incorrectly identified*. The authors proposed the replacement of habitat G1.22 with habitat **G1.A1 - Quercus-Fraxinus-Carpinus betulus woodland on eutrophic and mesotrophic soils** (1954.0ha or 35.8% of the site area) and of habitat G1.A4 with **G1.7 - Thermophilous deciduous woodland** (563.4 ha or 10.3%). It is, also, emphasized that complex, additional studies are needed on the grassland habitats, located mainly in the North-West and North of the "Vila Nisporeni" Emerald site. Thus, the list of valuable habitats within the site will expand.

The value of the "Vila Nisporeni" forest ecosystem is also reflected in the lichen chorology, which, in addition to the common species for the territory of the Republic of Moldova (10 species), appreciated in the ecological monitoring activity, also indicates the presence of 3 rare species for the country, such as: *Evernia divaricata, Ramalina fraxinea and Pertusaria discoidea* (species that deserve to be studied, in particular, to establish preferable habitats, with the aim of their conservation). The predominance of fruticose and foliaceous lichen species indicates the existence of mature forest communities which, on specimens with a large trunk circumference (40-45 cm), are already replaced by the next successional stage, respectively by bryophyte communities, and the relatively high number of identified lichen species contributes to increasing the complexity at the floristic biodiversity level (Donica et al., 2025).

Since most of the Emerald site under investigation overlaps with a protected natural area, the measures for the management of natural ecosystems in the site are those established in the Protected Area Management Plan (Law No.94/2007).
For sectors that are not part of the protected area, but which at the national level are considered forest ecosystems that host rare, endangered, threatened species, the main management measures refer to respecting the ecological requirements of the species (especially humidity and light) in forestry works, ensuring habitat continuity, interventions outside the vegetation season, reproduction and perpetuation of species, etc. (EU4 Environment, 2023).

4.6. Soil

The soils of the "Vila Nisporeni" Emerald site, mostly, respects the law of natural zonation, being present both the class of automorphic soils and the class of hydromorphic and dynamomorphic soils. At altitudes above 340m, in relatively humid climatic conditions, on Sarmatian deposits and under the influence of deciduous forests, brown soils with the luvic subtype were formed (Ursu, 2011), which represent 8.6% of the surface of the Emerald site (Fig. 8).

Gray soils, in the altitude range of 150-340m, are represented by 3 subtypes, 2 of which can be called zonal (typical) and one conditioned by the parent rock (clays). On the territory of the Emerald site, typical gray soils occupy an area of approximately 20% and descend to altitudes of 150 m, which is a regional peculiarity of soil geography (Ursu et al., 2004). The largest area belongs to soft gray soils with 38.5% of the Emerald site area, which were formed at altitudes lower than 340m, especially on the western and southern slopes, covered with oak forests. On an area of approximately 2% there are gray soils, which were formed on heavy clays rocks.

In the western and southern parts, on the lower third of the slopes, typical chernozems are found (1.95% of the total area of the Emerald site), which were formed under the influence of grassy vegetation, not being characteristic for this plateau region.

The hydromorphic soils class is scattered fragmentarily in the north and north-west, in the Nârnova watershed and occupies small areas – 1.02% of the site. Alluvial soils are young soils, with an area of only 1.63% of the total Emerald site and developed on the left tributaries of the Nârnova River. A share of over 5% of the total area is occupied by deluvial soils, which are part of the dynamomorphic class, and are formed both at the base of the slopes and in valleys with temporary runoff.
According to the soil map (Fig.8), approximately 22% of the Emerald site “Vila Nisporeni” is affected by landslides. The active ones represent about 10%, and the remaining 12%, although they are stabilized landslides, the soil cover on these lands is extremely complicated and presents a complex of mixed horizons.

4.7. Landscapes

Landscape is a complex and dynamic concept (Pătru-Stupariu, 2011), resulting from the interaction between natural and anthropogenic components, giving a territorial unit homogeneous features, both structurally and functionally. The European Landscape Convention (Florence, 2000) emphasizes the importance of protecting and sustainably managing all types of landscapes, whether natural or influenced by human activity. In this context, the delimitation of landscape types and the analysis of their distinctive character and diversity are essential steps for their sustainable use (Farina, 2006). The study of landscapes in the "Vila Nisporeni" Emerald site requires an integrated approach, taking into account both natural components, such as relief, hydrography, flora and fauna, and anthropogenic elements, including human settlements, infrastructure and land use. This holistic perspective allows the identification of landscape types,

the assessment of their current state and the appropriate measures proposal for their conservation and sustainable use.

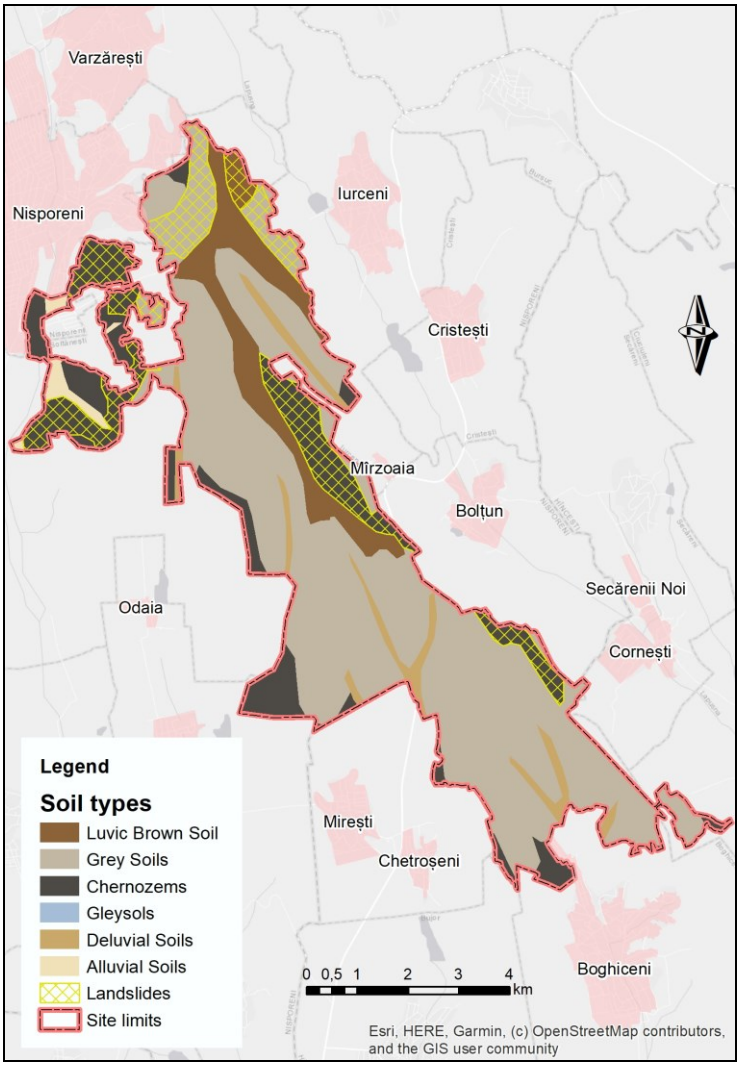

Figure 8 The soils from the "Vila Nisporeni" Emerald site (processing according to the Soil map, scale 1:200 000).

The landscape mosaic of the Emerald site "Vila Nisporeni" is relatively uniform (Fig. 9), with forest landscapes being predominant, covering an area of 4651.2 ha, which constitutes 89.0%. Such kind of ecosystem, dominated by natural landscapes, characterized by specific structures and functions, is essential for the long-term maintenance of biodiversity. It plays a fundamental role in achieving the conservation objectives of the Emerald network, contributing to the protection, ecological stability and biological diversity at national and European level.

On the site Emerald territory, grassland landscapes occupy a significant area of 425.7 ha, representing approximately 8.1% of the total area, being predominantly located in the northern part of the study region (Fig. 10). Arable landscapes and those intended for perennial crops present an uneven distribution, being more concentrated in the north of the site, but their cumulative area does not exceed 135 ha, equivalent to 2.6% of the entire territory.

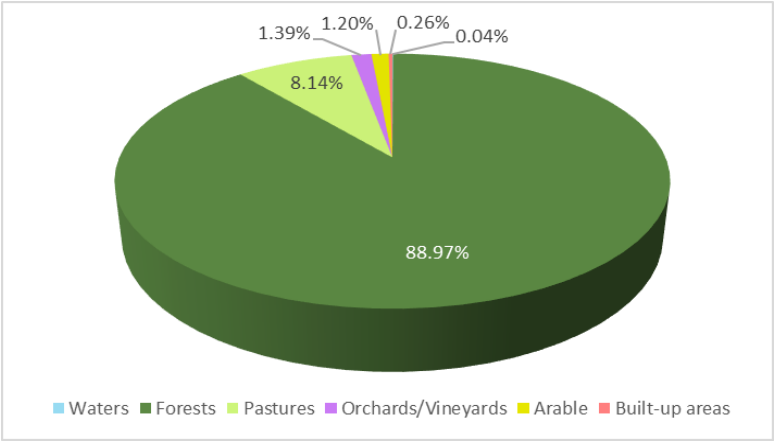

Figure 9 The share of landscape types in the Emerald site "Vila Nisporeni" (according to Corine Land Cover, 2024).

Built-up areas have a low share, of only 0.3% (13.7 ha), which indicates a low degree of infrastructural development in this region. As for aquatic landscapes, they have the lowest share of all the categories analyzed, covering only 2.3 ha (0.03%), which highlights the scarcity of aquatic resources within the site.

4.8. Profile of the physical–geographical vulnerabilities of the "Vila Nisporeni" Emerald site

The physico-geographical vulnerabilities of the "Vila Nisporeni" Emerald Site result from the complex interaction of the region's geological, geomorphological, climatic, hydrological, and pedological characteristics, each contributing in different ways to the high sensitivity of its natural ecosystems. The Sarmatian deposits composed of marls, clays, and sands, together with the Pliocene materials on the interfluves, confer low stability to the slopes, favoring the development of deluvial processes and landslides. This is confirmed by the fact that approximately 22% of the site's surface is affected by landslides, a considerable portion of which remain active, creating pedological discontinuities and weakening the stability of forest ecosystems.

The strongly fragmented relief, with altitudes ranging from approximately 150 m to 382.7 m, further amplifies these processes. Steep slopes, particularly those with northern and north-eastern exposures, are highly susceptible to erosion and instability, affecting habitat continuity and their capacity for natural regeneration. At the same time, the warming trend observed over recent decades, combined with high variability in precipitation, intensifies hydric stress on soils and vegetation, directly influencing sensitive ecosystems such as the oak forests, as well as areas hosting rare species, including *Paeonia peregrina* Mill.

Limited hydrographic resources represent another vulnerable component of the site. The low density of the hydrographic network and the near absence of natural standing waters result in a high dependence on precipitation to maintain hydrological balance. During dry years, reduced water availability diminishes soil stability and increases susceptibility to degradation. The dominant soils - brown soils, grey soils, and soft grey soils, are also prone to erosion, while deluvial soils, present in significant proportions, reflect the active geomorphological processes of the slopes and their limited capacity to support vegetation.

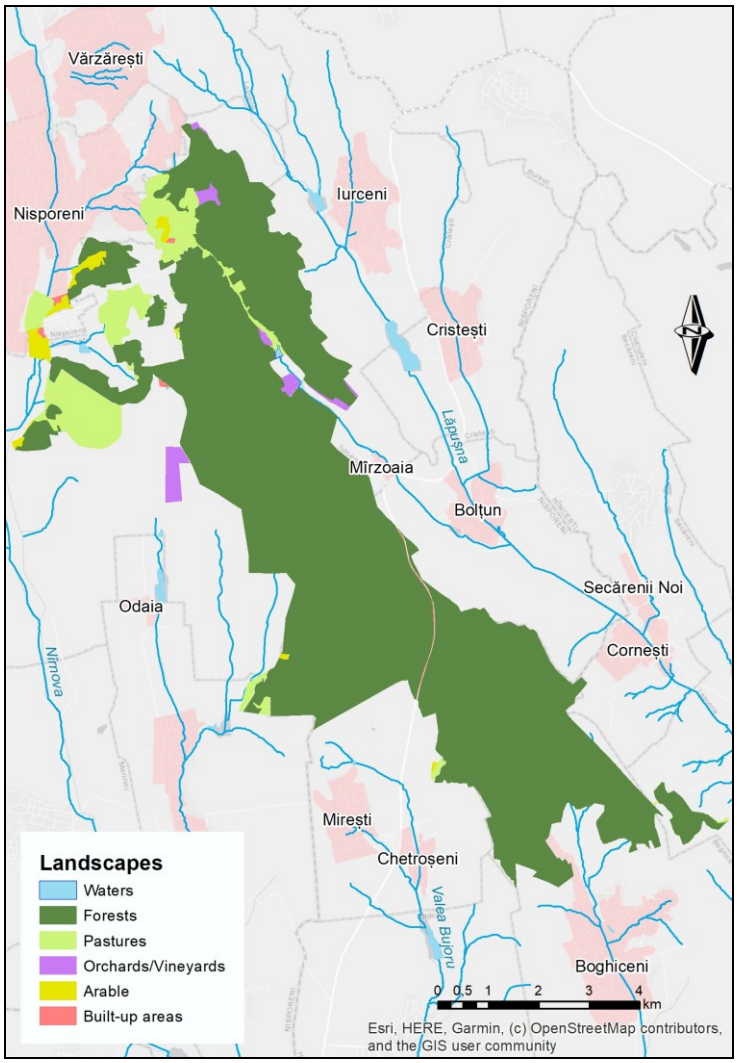

Figure 10 Spatial distribution of landscape types in the Emerald site "Vila Nisporeni" (according to Corine Land Cover, 2024).

Overall, the physico-geographical vulnerabilities of the “Vila Nisporeni” site are shaped by slope instability, active geomorphological processes, pronounced climatic trends, and a natural deficit of hydrological resources. These factors directly affect the integrity of habitats and need the inclusion of adaptive conservation measures within the management plan in order to maintain the ecological functionality of the site in the context of ongoing environmental change.

4.9. Pressures and threats on environmental components and ecosystems of the"Vila Nisporeni" Emerald site

Depending on the human activities time frame, all potential impacts are divided into two categories: current (existing) pressures and future (potential) threats, as follows:

a) Current pressure (P) - activities with potential negative effects on species or habitats that are currently occurring or have occurred in the past and that persist in the present;

b) Future threat (T) - activities that have potential negative effects on species or habitats and are expected to occur in the future (a current pressure cannot be considered a future threat unless it is expected to increase significantly or if the location of the current pressure changes), IUCN, 2024.

According to the analysis, the categories of pressures and threats considered to have the greatest impact on the environmental components of the researched site are:

- Climate change - (1.) Temperature changes and extremes caused by climate change and (2). Changes in precipitation regimes due to climate change. Both of them will have an impact on the entire forest ecosystem, but more intense in the N, NW, and SW periphery of the site, which in the future, against the background of climate change and inadequate management, especially of the tree target composition, may intensify as an impact;

- Alien and problematic species – (1). Alien species, mainly, the impact of invasive tree species (*Acer negundo, Ailanthus altissima, Robinia pseudoacacia*, etc.); in future will present a threat due to the invasive nature of the species, and inadequate management scenarios. (2) Diseases, pathogens and pests - impact on tree health, especially through defoliating insects, fungal diseases, bark pests, which may increase due to environmental changes, including climate change, favored the intensity and spread of invasions/diseases.

In order to ensure the ecological integrity of this Emerald site, it is necessary to implement adaptive and integrated management measures. These include aligning conservation objectives with those of the protected area, assessing and anticipating the impact of environmental factors and delimiting effective buffer zones to mitigate negative anthropogenic influences.

In order to preserve valuable natural ecosystems and specific biodiversity, we propose the following sustainable management measures for the “Vila Nisporeni” Emerald site:

- Continuing the identification and mapping of habitats of european/national interest, with the permanent updating of information on habitats through their monitoring;

- Annual assessment of the habitats status conservation; assessment in terms of surface area, structure, functions and future prospects;

- Promoting natural forest regeneration (silvic works that encourage natural regeneration, while maintaining the integrity of natural landscape units; forestry works appropriately and according to the execution schedule, in order to avoid disturbing the soil and injuring the established seedlings; planting works with native species; promotiion of the main forest species regeneration, as oaks; supporting young stands with care, clearing, cleaning, thinning, to eliminate secondary species; etc.);

- Maintaining in all forest plots, partially or totally dry trees, as well as fallen dead wood (due to their importance as a reproductive element and/or trophic base).

The success of these measures depends on an intersectoral approach, based on collaboration between social, political and scientific actors, in order to develop sustainable strategies, in line with current environmental conservation trends.

5. Conclusion

The Emerald Network plays a crucial role in biodiversity conservation, extending the principles of the Natura 2000 framework to non-EU countries and contributing to the long-term protection of natural habitats and wild flora and fauna. The physical-geographical characteristics of the “Vila Nisporeni” Emerald Site, including relief, climate, soils, and hydrographic resources, form the

environmental base that sustains its habitats and must be considered in planning and implementing appropriate conservation measures.

The highly fragmented plateau relief of the site has been shaped by the long-term interaction between endogenous and exogenous processes. The Moldavian Platform, composed of igneous and metamorphic rocks at depth and covered by Sarmatian–Meotian sedimentary deposits, provides a geological substrate that is inherently susceptible to instability. Erosional and gravitational processes play a defining role in the current landscape dynamics, acting both as natural drivers of landform evolution and as sources of geomorphological risk. Landslides alone affect more than 20% of the site's area, particularly in the north-western and western sectors, reflecting the fragility of slopes formed on friable marls, clays, and sands.

Local physical and geographical particularities have left their mark on the morphological characteristics of soil. Above 150 m, the combination of Sarmatian deposits, relatively humid microclimatic conditions, and deciduous forest cover has enabled the formation of forest grey soils, which dominate the area. Limited patches of typical chernozems occur where grassland vegetation persists, while hydromorphic and alluvial soils appear fragmentarily in the Nârnova watershed. These soil types, many of which are sensitive to erosion, contribute to the overall environmental vulnerability of the site.

Climate exerts an additional moderating, yet increasingly destabilizing influence on environmental components. Although the spatial distribution of precipitation aligns with national climate projections, which indicate up to a 10% increase in annual precipitation, the simultaneous rise of mean annual temperatures by approximately 1°C intensifies risks associated with climate change. Increased heat stress, higher evapotranspiration, and greater variability in the hydrological regime can exacerbate soil degradation, reduce slope stability, and negatively impact the local hydrographic network, already characterized by a low density and a marked deficit of natural standing waters.

The landscape mosaic of the "Vila Nisporeni" site is relatively uniform, with forest landscapes dominating 89% of the territory. These forest ecosystems contain significant concentrations of biodiversity at global, regional, and national levels, and host numerous rare, threatened, and endangered species. Natural stands of sessile oak, downy oak, and, to a lesser extent, pedunculate oak form habitats of European conservation interest. Particularly valuable are the downy oak (*Quercus pubescens*) communities, which support a unique assemblage of species, including the only wild population of *Paeonia peregrina* Mill. in the Republic of Moldova, spread over an area of approximately 3 ha. In this context, for the most intense pressures and threats recorded for this site (climate change and associated risks, alien species, pest and diseases), appropriate measures will be established in the protected area Management Plan.

Integrating the site's physico-geographical vulnerabilities, such as slope instability, active geomorphological processes, climatic stressors, and hydrological limitations, into its sustainable management plan is vital for ensuring the preservation of biological diversity and the long-term maintenance of geosystemic balance.

Overall, the protection and conservation of Emerald sites remain essential for maintaining biodiversity and ecological stability in the region. The natural habitats and landscapes of "Vila Nisporeni" site unified both physically and functionally, hold exceptional scientific, ecological, and aesthetic value.

References

Atlas of the Moldavian SSR. 1978. Academy of Sciences of the Moldavian SSR, Geography Department; Main Directorate of Geodesy and Cartography under the Council of Ministers of the USSR. Moscow, 131 p.

Atlas: Abiotic Environmental Factors and Ecological Security. 2023. Bejan Iu. (coord.). Ministry of Education and Research, Moldova State University, Institute of Ecology and Geography. Chișinău, Impressum Publishing House, 104 p. ISBN 978-9975-3586-8-2.

Atlas: Climate Change and the Current State of Landscapes. 2021. Raileanu V. (coord.). Ministry of Education and Research, Institute of Ecology and Geography. Chișinău, Impressum Publishing House, 100 p. ISBN 978-9975-62-439-8.

Bejenaru Gh. 2018. Assessment of the Hydrological Potential of the Republic of Moldova under Environmental Change Conditions. Doctoral Thesis Abstract in Geonomic Sciences, Chișinău, 194 p.

BirdLife. 2025. Important Bird and Biodiversity Areas (IBAs). Available at: https://datazone.birdlife.org/about-our-science/ibas

Boboc N. 2019. Physical-Geographical Regionalization of the Republic of Moldova. In: Atlas: Climate Change and the Current State of Landscapes, 2021. Chișinău, p. 73. ISBN 978-9975-62-439-8.

Butkachyuk P. D. et al., 1968. New Data on the Presence of Ancient Alluvial Deposits in the Prut-Dniester Interfluve. Proceedings of the Academy of Sciences of the USSR, No. 6, 178 p.

Convention on the Conservation of European Wildlife and Natural Habitats (Bern, 1979). Available at: https://rm.coe.int/1680078aff

Corine Land Cover, 2024. Available at: https://land.copernicus.eu/en/products/corine-land-cover?tab=datasets

Council of Europe. Landscape Convention. Available online: https://rm.coe.int/16802f3fb3.

Donica A., Begu A. Lichenodiversitatea ecosistemului forestier - situl Emerald „Vila Nisporeni": particularități ecologice și bioindicatoare. In: Sesiunea de Comunicări Științifice „D. Brandza"; Ediția a XXXI-a, Grădina Botanică a Universității din București, 14-15 noiembrie, 2025. Editura Universității din București. P. 55-57. ISSN 2971-883X, ISSN - L 2971-883X.

Emerald - Standard Data Form. MD00000028 Vila Nisporeni. Emerald Network General Viewer, European Environment Agency. Available at: https://natura2000.eea.europa.eu/Emerald/SDF.aspx?site=MD0000028.

Emerald Network - General Viewer. European Environment Agency Available at: https://emerald.eea.europa.eu/.

EU4Environment. 2023. Identification of High Conservation Value Forests in the Republic of Moldova. Washington, DC: World Bank.

EU4Environment. 2024. Guidelines for Developing Management Plans for Emerald Sites in the Republic of Moldova. Washington, DC: World Bank. Available at: https://www.eu4environment.org/app/uploads/2024/09/Guidelines-for-Developing-Management-Plans-for-Emerald-Sites-in-Moldova-ROM.pdf.

Farina A. 2006. Principles and Methods in Landscape Ecology: Toward a Science of Landscape. 2nd edition. Ed. Springer. 412p. ISBN-13 978-1-4020-3327-8 (HB).

GIS Tutorial for ArcGIS Desktop 10.8. 2020. Ed.: W. L. Gorr, K. S. Kurland. ESRI. Available at: https://en.pdfdrive.to/dl/gis-tutorial-for-arcgis-desktop-108-0

Government Decision No. 409 of 12 June 2024 on the approval of the Environmental Strategy for 2024–2030. Published: 30 July 2024, Official Gazette No. 325-328, art. 650.

Gunawan H., Setyawati T., Atmoko T., Subarudi, Kwatrina R., Yeny I., Yuwati T.W., Effendy R., Abdullah L., Mukhlisi, Tien Lastini T., Sari U.K., Sitepu B.S., Pattiselanno F., Kuswanda W., A review of forest fragmentation in Indonesia under the DPSIR framework for biodiversity conservation strategies, Global Ecology and Conservation, Volume 51, 2024, https://doi.org/10.1016/j.gecco.2024.e02918.

IUCN. 2024. Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria, Version 2.0. Keith, D.A., Ferrer-Paris, J.R., Ghoraba, S.M.M., Henriksen, S., Monyeki, M., Murray, N.J., Nicholson, E., Rowland, J., Skowno, A., Slingsby, J.A., Storeng, A.B., Valderrábano, M. & Zager, I. (Eds.). Gland, Switzerland: IUCN. Available at: https://portals.iucn.org/library/sites/library/files/documents/2024-021-En.pdf

Law No. 1538 of 25 February 1998 on the State Protected Areas Fund. Published: 16 July 1998, Official Gazette No. 66-68, art. 442.

Law No. 162 of 20 September 2017 for the amendment and completion of certain legislative acts. Published: 29 September 2017, Official Gazette No. 352-355, art. 588.

Law No. 94 of 5 April 2007 on the Ecological Network. Published: 29 June 2007, Official Gazette No. 90-93, art. 395.

Lozan A., Josu V., Gbedemah Ch., et al. 2019. Republic of Moldova. 6th National Report on Biological Diversity. UN Convention on Biological Diversity, UNEP/GEF Project. Chișinău, Bons Offices Printing House, 92 p.

Mârza M., Bulicanu D. 2019. Downy Oak (Quercus pubescens Willd.) Groves within the “Vila Nisporeni” Protected Area. In: Conference "Integration through Research and Innovation", Chișinău, Moldova, 7–8 November, pp. 173–177. ISBN 978-9975-149-47-1.

Mihăilă D. 2002. Some Aspects Regarding the Distribution and Regime of Atmospheric Precipitation in the Moldavian Plain. Annals of Stefan cel Mare University, Section G, Vol. XI, Suceava, pp. 55–66.

Mihăilă D. 2006. The Moldavian Plain – A Climate Study. Suceava University Press, 465 p.

Miron, A., Galupa, A., Donica, A., Tonofrei, S., Brașoveanu, C. Contributions to the forest habitats study of the "Vila Nisporeni" Emerald site. In: *Book of Abstracts.* Proceeding volume of the conference “Integrated Management of Environmental Resources” (ISSN 2537 – 3757). P.62-63. Disponibil on-line: https://silvic.usv.ro/imer2025/book_of_abstracts_IMER_7.pdf

National Geospatial Data Fund. 2025. geodata.gov.md (accessed on 07 March 2025).

Nedealcov M. 2020. Regional Climate Change. Institute of Ecology and Geography, Impressum Printing House, Chișinău, 366 p. ISBN 978-9975-3155-9-4.

Order of the Ministry of Environment No. 105 of 18 June 2024 on the approval of the Guidelines for Biodiversity Assessment. Available at: https://www.legis.md/UserFiles/Image/RO/2024/mo295-298md/Ghid_105.docx

Pătru-Stupariu, I. 2011. Landscape and Sustainable Land Management: Applications to the Bran–Rucăr–Dragoslavele Trans-Carpathian Corridor. Bucharest University Press, pp. 58–74. ISBN 978-606-16-0011-3.

Pînzaru P., Cantemir V., Manic Șt. 2016. Phytosociological Study of the Population of Paeonia peregrina Mill. (Paeoniaceae) in the Republic of Moldova. Journal of Plant Development, 23, pp. 167–177. Available at: https://plant-journal.uaic.ro/docs/2016/14.pdf

Postolache Gh. 2015. The Vegetation of the Republic of Moldova. 2nd edition. Moldova State University, Botanical Garden (Institute) "Al. Ciubotaru", Chișinău, Lexon-Prim, 519 p. ISBN 978-9975-172-96-7.

Postolache Gh., Lazu St. 2018. "Vila Nisporeni" Forest. In: Protected Natural Areas of Moldova. Forest Reserves. Chișinău, Știința, pp. 70–71. ISBN 978-9975-85-151-0.

Red Book of the Republic of Moldova. 2015. Ministry of Environment of the Republic of Moldova, Academy of Sciences of Moldova, Botanical Garden, Institute of Zoology. 3rd edition. Chișinău, Știința Publishing House, 492 p. ISBN 978-9975-67-998-5.

Reference list Threats. Pressures codes 2019-2024. European Environment Information and Observation Network https://www.eionet.europa.eu/etcs/etc-be/activities/reporting/article-17/docs/list_threats_pressures.xls

Spian C. 2023. Stratigraphic and Paleontological Study of the Volhynian Deposits in the Northeastern Part of the Prut–Dniester Interfluve. Doctoral Thesis in Geonomic Sciences, Chișinău, 175 p. Available at: https://anacec.md/files/Spian-teza.pdf

Ursu A. 2011. The Soils of Moldova. Chișinău, Știința Publishing, pp. 136–137. ISBN 978-9975-67-572-7.

Ursu A., Overcenco A., Marcov I. 2004. Geographical Particularities in the Northwestern Part of the Codri. Bulletin of the Academy of Sciences of Moldova, Biological, Chemical and Agricultural Sciences, No. 3 (294), pp. 135–142. ISSN 1857-064X.

*** Geological map with scale 1:200000, 1983- 1985 years

*** Soil maps with scale 1:200000, 1984-1985 years

*** SRTM – DEM for the territory of the Republic pf Moldova (resolution 30 m).