

The stational and potential favorability of forest habitats for plant and animal species located in ROSCI0076 Dealul Mare-Hârlău

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Abstract: Protected areas pose a major interest in the current context in which natural habitats are very fragmented as a result of economic development. The ROSCI0076 Dealul Mare-Hîrlău site represents the largest protected area from Moldova's Plateau where forest habitats occupy a majority surface. A total number of 10 Natura 2000 forest habitats were identified on the site's surface. Among them, the majority are 91Y0 - Dacian oak hornbeam forests and 9130 - *Asperulo-Fagetum* beech forests. These are comprised of 79% natural forests, while planted forests represent 19%. The main age ranges between 40 and 80 years, with compact areas with young forests, as well as with forests older than 100 years. Forest habitats are stable from an ecological point of view, ensuring optimum conditions for the development and colonization of species presented on the site's map.

1. Introduction

The development of protected areas had a late start and a slow evolution up to 1980, followed by a substantial growth brought by the adoption of legislative packages for protecting biodiversity (Geacu et al., 2012). The Natura 2000 network was outlined by the Romanian state's initiative of adhering to the community block (UE). In this way, the two directives from the European legislation have been implemented, namely the one regarding habitats (92/43 EEC/1992) and the one concerning birds (2009/79/409/CEE/2009). Based on them, 231 types of habitats have been identified, as well as 1563 animal species and 966 plants and vulnerable bird species that must undergo a protection regime (Manolache et al., 2017). The number has continuously increased from 1992 up to 2007, a period when the community block has also extended. The largest growth was recorded for the species from Appendix II of the Habitat directive with an addition of 264 species (Evans, 2012). Natura 2000 protected areas include in our country 2,656 million hectares of forests from a total of 6,404 million hectares (present in 2018) that are totally or partially overlaid in the 606 sites (Nichiforel et al., 2021). The national silviculture legislation (Law no. 5/2000 and Law no. 48/2008) has promoted the natural fundamental forest type defined as *the natural way of associating species (arborescent and herbaceous) in a stational complex that excludes anthropic interventions and pioneer species that might install themselves before the species that are characteristic for the ecological complex* (Duduman & Drăgoi, 2019). From an ecological perspective, vegetation represents an ecosystem that includes phytogenesis

and phytopopulation which form phytocenosis at a geographical level, also known as vegetal layer territorial (Ivan & Doniță, 1975). Moldova's Plateau has an approximate surface of 2,29 mil ha, with common altitudes of 250-500m (Roșu, 1973). The surface covered by sites included in the Natura 2000 network is 0,27 mil ha, from which 0,13 mil ha are sites of community importance (SCI) and 0,14 mil ha are Special Avifaunistic Protection Areas (SPA). Compared to the national average of 26,04% (Ursu et al., 2020), the coverage on the relief's surface is only 11,7%. An explanation could be the reduced forest coverage of only 14,4%, in the context in which over 80% of their surface is already included in the natural network of protected areas.

2. Material and method

The community importance ROSCI0076 Dealul Mare-Hârlău site is located in Moldova's Plateau, at the intersection of Iași, Botoșani and Suceava counties (Figure 1).

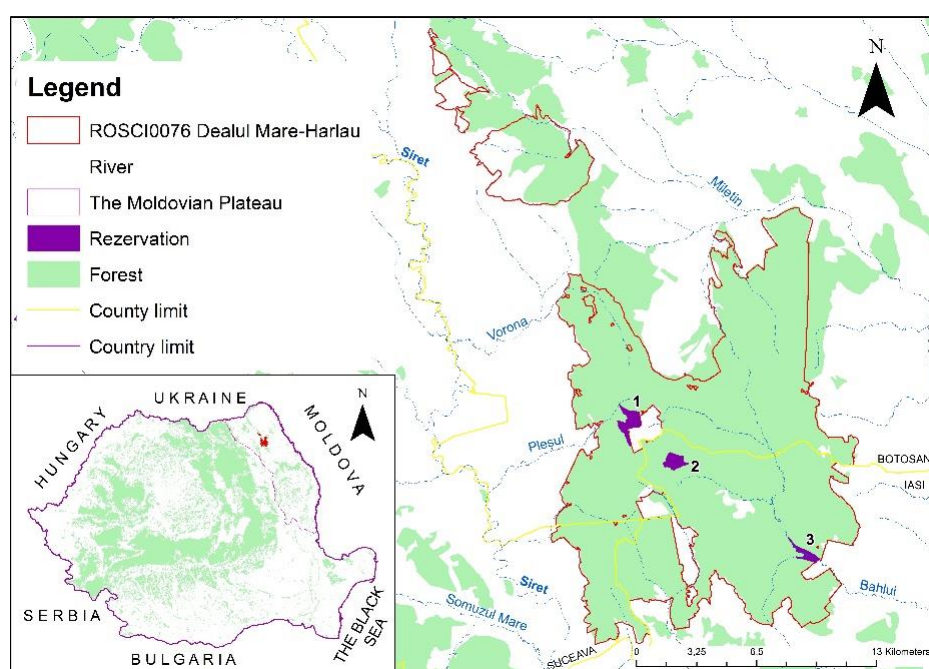


Figure 1. ROSCI0076 Dealul Mare-Hârlău location (1-Tudora forest, 2-Humosu Forest, 3- Pârcovaci accumulation)

Dealul Mare-Hârlău forest massif is the largest compact forest area from the plateau and is composed of pure common beech, holm and pedunculate oak forests as well as mixtures with hornbeam, ash, linden and other broad-leaved species. The site contains two forest reservations and one aquatic reservation declared as protected areas through Law 5/2000 - *concerning the approval of the national field management plan - Section III - protected areas*, namely: Tudora Forest (created for protecting *Taxus baccata* - yew), Humosu secular common beech stand (created for conserving secular examples of *Fagus sylvatica* - common beech) and Pârcovaci Accumulation (resulted after constructing the Bahlui dam with a protective role in the created aquatic ecosystem) (Geacu, 2006).

Silvicultural maps are created on the occasion of forest management plans by using GIS methods by owners, administrators or production units (U.P.). The database created for each management unit, generically named u.a., presents information about stational conditions, forest formations, forest species and their biometric data. All this information is realized under a codified form on the occasion of forest management works and automatically operated in the AS program. Using GIS methods in silviculture has been developed together with the interest of forest managers towards the digitalization of silvicultural works, leading to the basis of forest geomatics (Petrila et al., 2010). In order

to identify habitats, their classifications have been published and contain correspondences between our national habitats and those from European ecosystems (Donita et al., 2005, 2006), as well as clarifications regarding their interpretation (Gafta & Mountford, 2008). In the case of forest habitats, the main correspondence sign is the natural forest fundamental type (F.T.) established in regard to stational and vegetation conditions and used in the present study. The current character of the forest type is determined by confronting the current composition of the forest with its regeneration method, both natural (seed or sprouts) and artificial (seedlings). This is defined by the degree of change from the natural fundamental forest type. Natural fundamental forests that originate from natural regenerations distinguish themselves and they are formed of one or more base species (common beech or oak in the present case) that correspond to the natural vegetation conditions. Another category is represented by partially derived forests composed of base species in a percentage higher than 20% and that can be brought back to a state corresponding to a natural type through works. Totally derived forests are formed of temporary species improper to the natural type that require a set of complex works (maintenance) that in the end cannot improve the substituted composition. The last category is represented by artificial forests (planted/disseminated) composed of species close to the natural type or with a different composition (Dinca et al., 2020; Crisan et al., 2021). As such, we can appreciate the habitat's naturalness degree through the complex of applied measures from the past and the ones proposed by the silvicultural management for the future (Long et al., 2021; Pelleri et al., 2021).

3. Results and discussions

A total number of 10 Natural 2000 habitats (Figure 2) have been identified after centralizing the information from forest management plans (in the surface of 23338 ha, from which the fields that do not have a forest usage have been excluded). Among them, 5 have been signaled in the ROSCI0076 site's card in the declaration moment. Their distribution is not uniform and unbalanced from the perspective of the occupied space. The majority share is represented by habitats 91Y0 - *Dacian oak-hornbeam forests* with a 61% coverage and 9130 - *Asperulo-Fagetum* beech forests with 36%. The other habitats are 9170 - *Galio-Carpinetum* oak-hornbeam forest, 9110 - *Luzulo-Fagetum* beech forest, 9150 - Medio-European limestone beech forest, 91E0* -Alluvial forest with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnionincanae*, *Salicion albae*), 91F0 - Riparian mixed forests of *Quercus robur*, *Ulmus laevis*, *U. minor*, *Fraxinus excelsior* or *F. angustifolia* along the great rivers (*Ulmenionminoris*), 91M0 - Pannonian - Balkanic turkey oak – sessile oak forest, 91V0 - Dacian beech forest, 92A0 - *Salix alba* and *Populus alba* galleries.

The plant species associated with the 9130 habitats are: *Melampyrum bihariense*, *Dactylis polygama*, *Ranunculus auricomus*, *Stellaria holostea*, *Crocus heuffelianus*, *Lathyrus hallersteinii*, *Dentaria bulbifera*, *Anemone ranunculoides*, *Anemone nemorosa*, *Asarum europaeum*, *Galium odoratum*, *Carex sylvatica*, *Dactylis polygama*, *Lamium galeobdolon*, *Lathyrus vernus*, *Milium effusum*, *Mercurialis perenis*, *Primula vulgaris*, *Pulmonaria officinalis*, *Sanicula europaea*, *Viola rechenbachiana*, *Melitis melissophyllum*, *Campanula persicifolia*, *Lathyrus niger*, *Alium ursinum*. For the habitat type 91Y0 the specific flora consists of: *Anemone ranunculoides*, *Anemone nemorosa*, *Alium ursinum*, *Corydalis cava*, *Corydalis solida*, *Dentaria bulbifera*, *Ranunculus ficaria*, *Scilla bifolia*, *Ajuga reptans*, *Actaea spicata*, *Cicuta lutetiana*, *Convallaria majalis*, *Carex pilosa*, *Carex sylvatica*, *Dactylis polygama*, *Euphorbia amygdalodes*, *Lamium galeobdolon*, *Lathyrus vernus*, *Mercurialis perenis*, *Polygonatum multiflorum*, *Pulmonaria officinalis*, *Sanicula europaea*, *Stachys sylvatica*, *Salvia glutinosa*, and *Viola sp.*

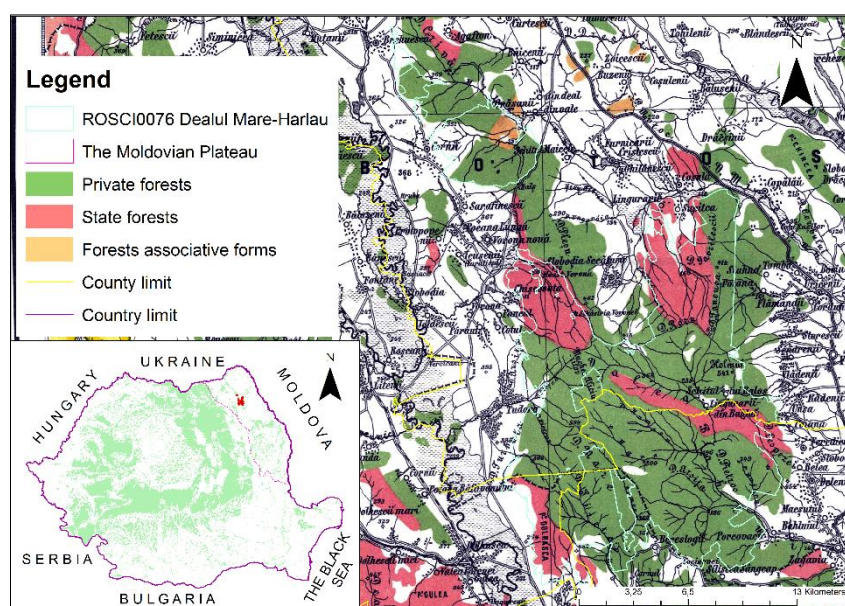


Figure 2. Forest situation in 1900 * (source: Forest map by owner categories)

The current character of forest type is rendered in Figure 3, being divided into five categories. Natural forests with base species (common beech, holm, pedunculate oak) are in majority, occupying 60%, with 17% for the partially derived ones and 2% for the totally derived ones. Plantations represent 19% of the studied surface and are represented by Norway spruce forests concentrated on large surfaces in the Sirtel basin and on the right-side tributaries of the Bahlui river.

Figure 4 presents the current situation of forests in each type of habitat. It can be seen that the forests are both natural and planted. The plantations are comprised of resinous or broad-leaved species after the totally derived forests have been replaced (composed mainly of hornbeam and linden).

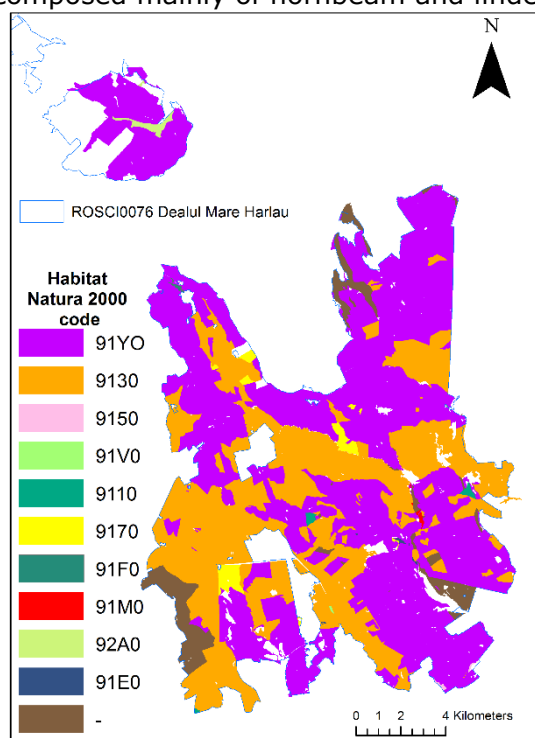


Figure 3. Forest habitat from ROSCI0076

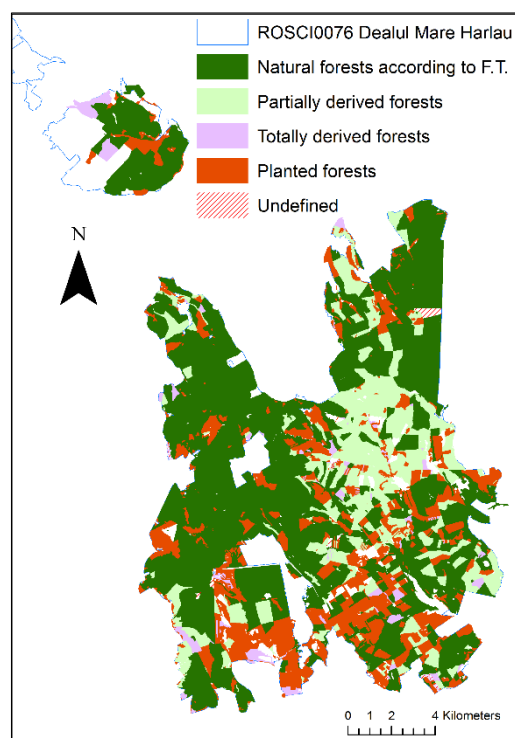
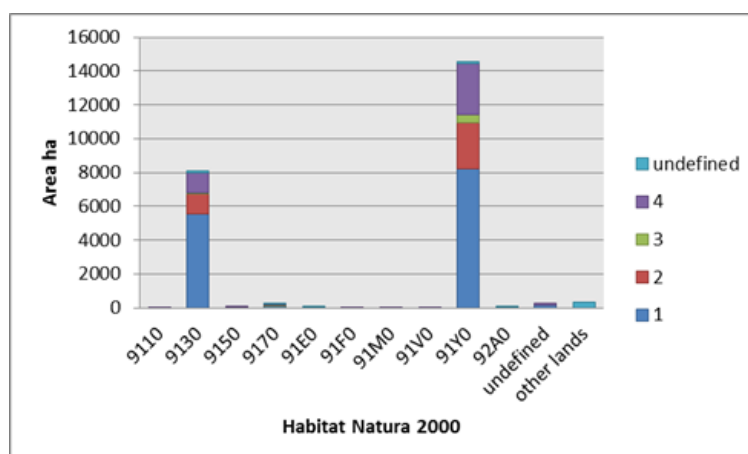


Figure 4. The current character of the forest type

The forests that form the described habitats have ages between 2 and 190 years (Figure 5). The highest percentage is represented by forests between 40 and 80 years (61%). Forests over 100 years have a surface of 4200 ha, which represents approximately 18% of the site's afforested surface (Figure 6). The current creation of habitats is the result of past forest management that has mainly depended on the property type and the reduced interest for ensuring continuity of forest regeneration through seeds with species with a high economic and ecologic value (common beech and oak).



1-natural forests with species, 2-partially derived forests, 3-totally derived forests 4- plantations

Figure 5. Current forest character based on the habitat

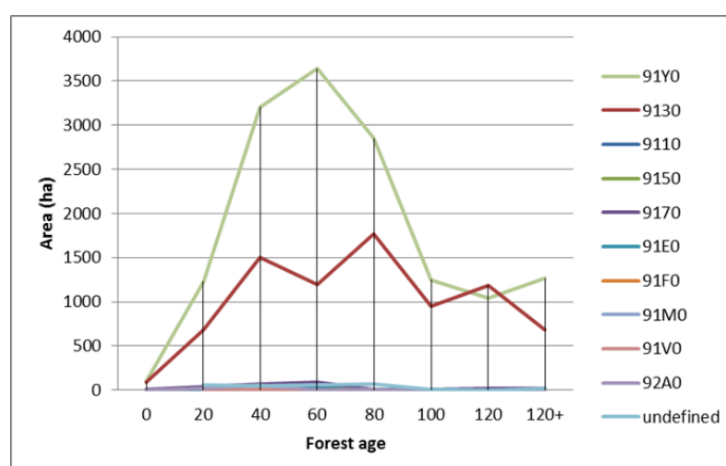


Figure 6. Distribution of forest habitats on age class

Besides this, forests have also been affected by agrarian reforms that have cleared considerable surfaces for ensuring agricultural fields and meadows for inhabitants near the forest massif (Figure 2). These areas have been limitrophe to cities or around existing clearings, leading to the fragmentation of the highest habitat from within the Plateau. Landscape and habitat fragmentation is also the result of silviculture and agriculture development in order to ensure consistency and continuity to forests with closed structures by limiting cuttings (Miklín & Čížek, 2014), up to 3 ha for our country. This tendency to reduce habitats at a European level can also be observed by analyzing military maps and different satellite images (Hooftman & Bulloc, 2012; Biró, 2018). The natural fundamental forest type signals the habitat type that corresponds to a certain station. In order to declare a habitat, the biocenosis (associations) that compose it must be well outlined (Gafta & Mountford, 2008). Forest plantations have been created by replacing hornbeam or linden forests with species-specific to the forest's natural type,

namely with the habitat's type. Another type of plantation is those composed of resinous species (Norway spruce and pine) introduced between 1970-1985 (Vlad et al., 2019; Dinca et al., 2019; Murariu et al., 2021). They have been replaced from 2010 to 2011 after the attacks produced by *Ips duplicatus* (Duduman et al., 2011; Dinu et al., 2012). However, planted forests can ensure conditions for the development of plant or animal species as in a natural forest, even though they are sometimes considered *ecological deserts* (Brockhoff et al., 2008). Nowadays, private property represents a quarter of the site's surface, while the owners' interest is reduced in regard to creating or maintaining stable natural habitats. However, the perception regarding replacing Norway spruce plantations with broad-leaved species-specific to the natural fundamental type is seen as a clearing activity especially when it happens in a protected area. This fact was also signaled in other areas of Europe where they try to replace resinous species (De Valck et al., 2014).

The species presented in article 4 from Directive 2009/147/CE, and species from Appendix II to Directive 92/43/CEE are: *Lutra lutra* (otter), *Spermophilus citellus* (gopher), *Bombina variegata* (bittern with a yellow belly), *Emys orbicularis* (water turtle), *Arytrura musculus* (moth), *Lycaena dispar* (swamp red butterfly), *Cypripedium calceolus* (Venus's slipper).

Lutra lutra (otter) prefers exclusive aquatic habitats. It can be found along rivers and springs with permanent water from forest habitats as it looks for food or as it migrates towards other areas with more food. The species retreats in galleries made by foxes or badgers or under slant shores protected by arbustive vegetation or reed (Ionescu & Adămescu, 2013). The favorite area is Parcovaci Accumulation and Bahlui river, upstream of the dam where its marks have also been signaled (Bouros, 2014).

Spermophilus citellus (gopher) presents optimal conditions in the site's Nordic area where two meadow areas exist as well as inside the forest massif where different sizes of clearings exist, used as meadows, agricultural fields or fields for feeding game (Figure 7). Low-intensity grazing and large fields with herbaceous vegetation are favorable for the specie's conservation (Ionescu & Adămescu, 2013). The optimum density in natural favorable habitats is 18-68 individuals/ha (Kenyeres et al., 2018). Being an endemic species in a central European area, efforts were made for repopulating the areas occupied by the species in the past (Stoyanov et al., 2013; Koshev et al., 2018; Kachamakova et al., 2019).

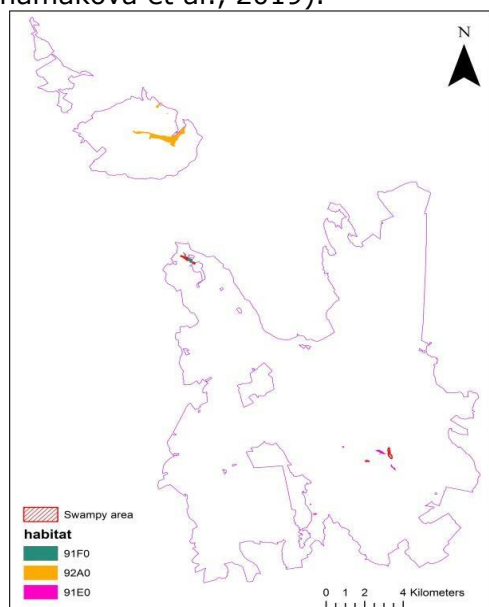


Figure 7. Areas favorable for *Bombina variegata* and *Emys orbicularis*

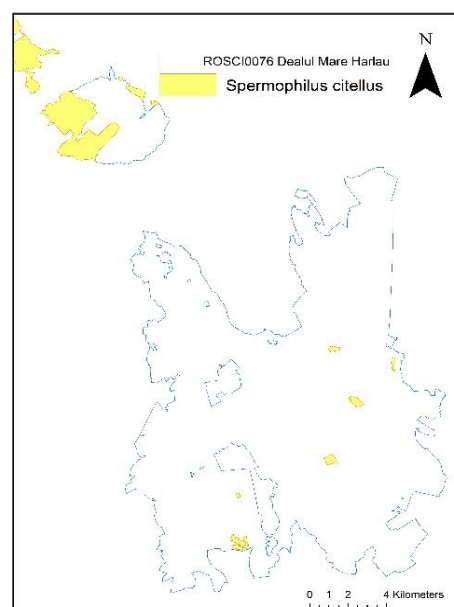


Figure 8. Areas favorable for *Spermophilus citellus*

Bombina variegata (bittern with a yellow belly), *Emys orbicularis* (water turtle), *Arytrura musculus* (moth), and *Lycaena dispar* (swamp red butterfly) can be found on the entire site's surface, along Bahlui river and in springs with permanent or semipermanent water, as well as in areas with swamps (Figure 8), emphasized in forest management plans and the following types of habitats: 91E0* -Alluvial forest with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnionincanae, Salicion albae), 91F0 - Riparian mixed forests of *Quercus robur*, *Ulmus laevis*, *U. minor*, *Fraxinus excelsior* or *F. angustifolia* along the great rivers (Ulmenionminoris), 91M0 - Pannonian - Balkanic turkey oak – sessile oak forest, 91V0 - Dacian beech forest, and 92A0 - *Salix alba* and *Populus alba* galleries. The populations are considered a bit vulnerable from the effective perspective (Török et al., 2013).

Cypripedium calceolus (Venus's slipper) can be found in optimum conditions in the following associations, based on its ecological requirements (Figure 9): 42 Hill pure common beech stands (Fageta submontana) and 43 Mixed common beech stands (Fageta composita). They correspond to the following Natura 2000 habitats: 9130 - Asperulo-Fagetum beech forests and 91V0 - Dacian beech forests (Mihăilescu et al., 2015). As a mesophytic species, moderately acidophile - neutrophil, mesotrophic and calcifil (Bozga Candrea et al., 2013), it can be found alongside plants of average up to high trophicity with V=40-100% (*Asarum europaeum*, *Asperula odorata*, *Brachypodium silvaticum*, *Galium schultesii*, *Geum urbanum*, *Glechoma hirsuta*, *Lathyrus vernus*, *Pulmonaria officinalis*, *Salvia glutinosa*, *Sanicula europae*, *Stelaria holostea*) and moist up to moist-humid soils (*Arum maculatum*, *Asarum europaeum*, *Asperula odorata*, *Brachypodium silvaticum*, *Cardamine bulbifera*, *Euphorbia amygdaloides*, *Geranium robertianum*, *Geum urbanum*, *Mercurialis perenis*, *Mycelis muralis*, *Polygonatum latifolium*, *Pulmonaria officinalis*) (Chirita et al., 1964). The species was signaled in Pădurea Tudora Reservation (Bîrsan et al., 2017), unconfirmed recently as being present.

The restrictive and destabilizing factors (Figure 10) are quantified in management plans based on their production method and their intensity. They are represented by landslides, rock present at the surface, erosion, industrial noxa pollution, swamp, drying, windbreaks, snowfall, damages caused by game species, lesions caused by the exploitation work, grazing, fires, and unhealthy roots (Crisan et al., 2020; Timiș-Gânsac et al., 2020; Araminiene et al., 2020).

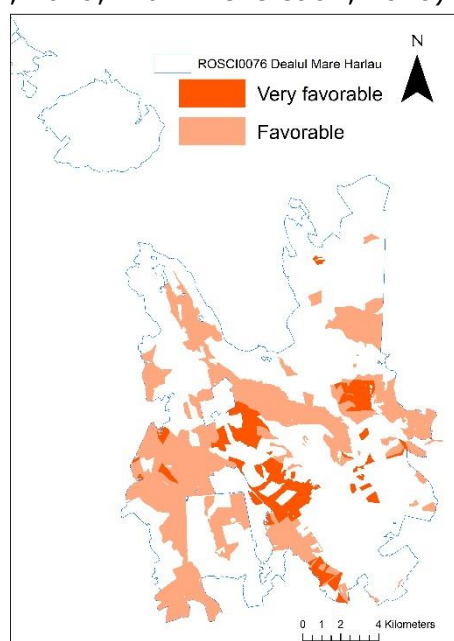


Figure 9. Favorable areas for *Cypripedium calceolus*

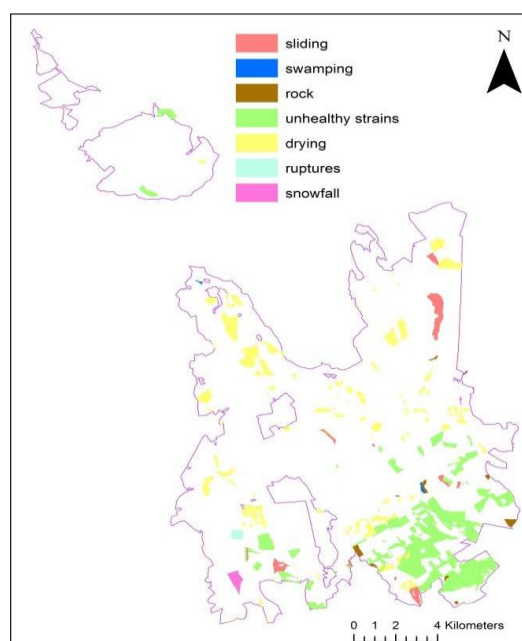


Figure 10. Restrictive and destabilizing factors

The analysis of destabilizing and restrictive factors can be used in mapping habitats from a conservation perspective (Velázquez et al., 2010). This can be combined with data regarding climate from which complex maps can result concerning the favorability degree by using the specie's ecological cards (Roşca et al., 2019; Şimonca et al., 2019). In the present case, the factors that affect forests are the drying of resinous species located outside the area and being attacked by insects. The second factor is represented by unhealthy trunks from forests regenerated from sprouts that were abused by grazing.

The limits of protected areas mention the following animal and plant species (Table 1).

Table 1. Other important species within the protected area

Species	Endangering degree	Effective
<i>Capreolus capreolus</i>	vulnerable	561
<i>Cervus elaphus</i>	vulnerable	129
<i>Felis silvestris</i>	rare	47
<i>Martes martes</i>	vulnerable	53
<i>Mustela putorius</i>	vulnerable	52
<i>Sciurus vulgaris</i>	vulnerable	unassessed
<i>Cardamine glanduligera</i>	rare	unassessed
<i>Cephalanthera damasonium</i>	rare	unassessed
<i>Cephalanthera longifolia</i>	vulnerable	unassessed
<i>Dactylorhiza maculata</i>	rare	unassessed
<i>Epipactis helleborine</i>	rare	unassessed
<i>Galanthus nivalis</i>	Least Concern	unassessed
<i>Gentiana asclepiadea</i>	threatened	unassessed
<i>Gentianella ciliata</i>	threatened	unassessed
<i>Melampyrum bihariense</i>	threatened	unassessed
<i>Orchis purpurea</i>	threatened	unassessed
<i>Platanthera bifolia</i>	threatened	unassessed
<i>Silene vulgaris</i>	threatened	unassessed
<i>Symphytum cordatum</i>	threatened	unassessed
<i>Taxus baccata</i>	rare	-

Animal effective were realized after centralizing cinegetic funds that overlay our studied area (Cazacu et al., 2014; Dinca et al., 2018; Fedorca et al., 2021).

4. Conclusions

The extension of forest that comprise the community interest ROSCI 0076 Dealul Mare-Hârlău site on a rather compact area offers optimum conditions for the development of species mentioned on the site's map as well as other unsigaled ones. The information provided by forest management plans helps in establishing the health of forest habitats from the perspective of their formation, and the destabilizing and restrictive factors that have appeared after each decade from the appliance. Natural forests are well represented (79%), with the largest percentage in the north and west parts, and a more reduced one in the south, south-east and south-west where they are replaced by plantations. Reducing the fragmentation of the forest fund with silvotechnical works and keeping the areas as compact as possible represent an important objective for maintaining naturalness and biodiversity. In the future, it is recommended to adopt leveling works for cuttings, resulting in compactly regenerated surfaces and the avoidance of present strips.

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