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UMBRELLA EFFECT OF EUROPEAN PROTECTED SPECIES OVER NATIONAL RED LISTED *BETULA HUMILIS* SCHRANK - "MESTECĂNAȘUL DE LA COȘNA" AS A NEW NATURA 2000 SITE

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Abstract

Betula humilis Schrank is a rare, glacial relict species primarily found in eutrophic peatlands. In Romania, it is limited to the Carpathian depressions of Transylvania and Bukovina, marking the southernmost boundary of its European distribution. Due to drainage and land-use changes, Betula humilis populations have declined and are nationally endangered. Despite these threats, a population of over 50 shrubs was mapped from Coșna area (Suceava County), making it one of the largest known populations in Romania. As part of a peatland restoration project, our efforts aimed at restoring the optimal hydrological regime to protect Betula humilis. During the area's flora and fauna inventory, two European protected species were discovered: Lycaena helle (an endangered butterfly) and Ligularia sibirica (a rare glacial relict plant). These findings highlight the site`s exceptional conservation value, leading to an expansion of the initial proposal for a Botanical Reserve of local interest to a broader Natura 2000 site covering 21 hectares. A management plan is needed to protect both Betula humilis and its umbrella species.

Key words*: Betula humilis, endangered species, Natura 2000, peatland restoration.*

INTRODUCTION

Peatlands are among the most valuable terrestrial ecosystems, covering approximately 3% of the Earth's land surface, yet storing about one-third of global soil carbon (Harenda et al., 2018; Leifeld & Menichetti, 2018). They play a critical role in climate regulation and provide essential ecosystem services, including water filtration, flood mitigation, nutrient cycling, resources for local communities' livelihoods and cultural heritage (Joosten & Clarke, 2002; Limpens et al., 2008; Bonn et al., 2016). Additionally, peatlands host a distinctive assemblage of plant and animal species, many of which are rare, endangered, or specifically adapted to acidic, waterlogged, and nutrient-poor conditions (Joosten et al., 2017). Globally, an estimated 12% of peatlands have been degraded (UNEP, 2022), while in Europe, this figure rises to 25%, and up to 50% within the European Union (Tanneberger et al., 2021). In the last two centuries, many European peatlands have been drained for agriculture, forestry, and peat extraction, leading to severe habitat loss (Verhoeven, 2014; Swindles et al., 2019). To counteract these impacts, efforts must focus on implementing restoration measures, including close collaboration between scientists, local policymakers, and community stakeholders to ensure sustainable land-use planning and peatland management practices (Pop et al., 2025).

The 2030 Conservation Goals, established by the EU Biodiversity Strategy and the Global Biodiversity Framework, aim to protect 30% of land and marine areas by 2030, with a strong focus on habitat preservation and ecological restoration (European Commission, 2020; CBD, 2022). This objective is particularly crucial for *relict species*, whose survival depends on conserving peatland ecosystems, increasingly threatened by land-use changes, and climate shifts. Given their vital role in climate change

mitigation, peatlands are a priority for ecological restoration initiatives.

Since peatland distribution is primarily governed by climate, bedrock composition, and topography, their extent in Southeastern Europe remains limited (Joosten et al., 2017). According to Tanneberger et al. (2017), organic soils with a peat layer (exceeding 20 cm and more than 20% organic matter content) cover approximately 7,690 km², representing 3.23% of Romania's surface. However, only 1347 ha of peatlands (oligotrophic acidic mires, locally known as *tinov*) are included in protected areas (Joosten et al., 2017).

According to Pop (1960), who extensively studied Romania's peat bogs, Bukovina is country's most representative and floristically rich peatland regions, characterized by extensive marshy areas and thick peat deposits. Within this landscape, the upper Dorna Basin, particularly the Coșna and Poiana Stampei areas, represents the core zone where oligotrophic peatlands reach their highest abundance and ecological authenticity. Between 2022 and 2024, the Institute of Biology Bucharest of Romanian Academy implemented the PeatRO 2 Project, focusing on the restoration of 12 degraded wetland ecosystems across 719.4 ha in Suceava, Brașov, and Sibiu Counties. Among these, the peatland near Coșna school (Suceava) emerged as a site of exceptional conservation importance, supporting one of the largest known populations of the rare shrubby birch, *Betula humilis* Schrank in Romania, along with other protected species of European interest.

These findings initiated plans to propose the area hosting *B. humilis* as a 1 ha local reserve, with the aim of extending its protection to 21 ha as a Natura 2000 site.

B. humilis is a glacial relict shrub adapted to cold, moisture-rich environments (Pop, 1976; Szatmari & Hurdu, 2022), thriving in diverse wetland habitats such as oligotrophic and eutrophic peatlands, transition mires, and wet meadows (Załuski et al., 2001; Jabłońska, 2012; Shaw et al., 2014).

It has an extensive yet fragmented global distribution across subarctic and subalpine regions of Eurasia, stretching eastward as far as Korea. In Europe, its distribution ranges primarily through the boreal regions of Scandinavia, continuing through Central and Eastern Europe, with its southernmost boundary in the Romanian Carpathians (POWO, 2025).

In Romania, the distribution is restricted to the Carpathian depressions of Transylvania and Bukovina, (Pop, 1928, 1960; Georgescu, 1952; Oprea, 2005).

According to the IUCN Red List global assessment (Shaw et al., 2014), *B. humilis* is currently classified as Least Concern (LC), with a decreasing population trend. Across Europe, the absence of conservation measures has resulted in severe declines, rendering the species vulnerable or rare in several countries. In Poland, some populations have drastically declined (Chrzanowska et al., 2016), while in the Czech Republic, it has been declared extinct (Kaplan, 2017). It is also critically endangered in the Carpathians (Witkowski et al., 2003) and Romania (Dihoru & Negrean, 2009). Table 1 presents various assessments of its endangered status in Romania.

Table 1. Conservation status in Romania, according to some authors (LC - Least concern; CR - critically endangered; EN - endangered; E/R - endangered/rare; V - vulnerable, ML - local monument)

Authors	Category of threat
Oltean et al., 1994	E/R
Boșcaiu et al. 1994	E
Dihoru & Dihoru, 1994	V
Ciocârlan, 2009	R
Witkowski et al., 2003	CR - in Carpathians EN - in Romania
Dihoru & Negrean, 2009	CR
OUG 57/2007	ML
IUCN Red list	LC

While most Romanian peatlands benefit from some form of legal protection, either as reserves (Borsaros-Sâncrăieni Nature Reserve, Beneș Nature Reserve) or as part of Natura 2000 sites (ROSAC0247 Tinovul Mare Poiana Stampei, ROSAC0245 Tinovul de la Românești), several populations of *B. humilis* remain unprotected or insufficiently monitored.

One of the most significant populations of *B. humilis* in Romania was recorded in Borsaros-Sâncrăieni Nature Reserve, previously considered the largest in the country (Goia & Farcaș, 1997). This site also marks the southernmost point of the species' Romanian and European distribution. However, in the late decades, human activities, including deforestation, drainage, and infrastructure

development, have led to a significant decline in the *B. humilis* population, reducing its habitat and threatening its long-term survival. Much of the population has been accidentally cut down, leaving only tens of individuals remaining (Pricop et al., 2019).

A broader assessment of *B. humilis* populations in Romania, summarized by Dihoru & Negrean (2009), highlights similarly critical declines across other reserves: Borsec - a single, fenced specimen remains; Remetea, Mlaștina cea Mare - 7 shrubs recorded in 1954; Honcsok Reserve - 8 shrubs recorded in 1952; Beneș Reserve - 14 shrubs recorded in 1952; Hármas Liget Reserve (Dumbrava Întreită) - 2 shrubs recorded in 1934. These observations show the ongoing decline of the species throughout its historical range, reinforcing the urgent need for targeted conservation measures. A recent study on peatland conservation revealed that only 17% of peatlands are protected worldwide, significantly less than many other high-value ecosystems (Austin et al., 2025).

Thus, the designation of "Mestecănașul de la Coșna" as a local reserve and a Natura 2000 site represents a significant step forward in securing the long-term conservation of *B. humilis*, addressing gaps in protection at both the national and European levels.

This study aims to assess the conservation importance of the Coșna peatland for *B. humilis* and other protected species; evaluate the role of EU-listed species (*Lycaena helle*, *Ligularia sibirica*) in strengthening site protection through the "umbrella effect" and provide a scientific basis for the designation of "Mestecănașul de la Coșna" as a Natura 2000 site, ensuring long-term protection of its habitats and species.

MATERIALS AND METHODS

Study area

The "Mestecănașul de la Coșna" site (47.372837° N, 25.174266° E) is located within the administrative territory of Coșna locality, Suceava County.

Biogeographically, it belongs to the alpine region. Geographically it lies in the northern sector of the Eastern Carpathians, within the southwestern part of the Suhard Mountains, inside the Dorna Depression (857 m a.s.l.).

Geologically, the area lies within a region of crystalline schists and Eocene sandstones. The peat deposits are separated from the underlying bedrock by a layer of siliceous alluvium, which forms the bog floor (Pop, 1960). The climate in the area is temperate-boreal montane, subalpine with influences from both the continental east and the sub-Baltic boreal north. The mean annual temperature is 5.1°C with an average annual precipitation of 657.4 mm, water supply and low temperatures being crucial for sustaining the site as a viable ecological component (Anonymus, 2015).

The study area is located within the Teșna River basin, with its main left tributaries, Tocila and Bancu, shaping the local hydrological system. The site is practically enclosed on three sides by water, as these streams flow around it before converging near the village of Coșna. Following their confluence, the Teșna flows into the Dorna River, which serves as the region's primary drainage system (Figure 1).

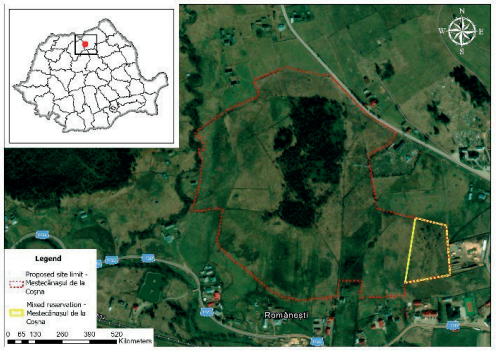

Figure 1. Proposed limit of Natura 2000 site Mestecănașul de la Coșna within the Coșna region (red dotted line), Suceava County, Romania; Reserve area (yellow) and close surroundings

The substrate consists of acidic peat, with soils classified as histosols (Doniță et al., 2005). The region falls within the montane vegetation zone, characterized by exceptionally compact spruce forests. In terms of nearby protected areas, the proposed site is situated in close proximity to the Natura 2000 site ROSAC0245 Tinovul de la Românești. In the old literature the site is known as the peaty terrain behind Coșna School (Pop, 1960).

Field survey

The biodiverisity survey within the proposed Natura 2000 site "Mestecănașul de la Coșna" began with an exploratory assessment in spring 2022, to identify key habitats and conservation priorities, in order to develop a restoration strategy. The evaluation focused on determining priority areas for intervention, mapping drainage channels, identifying species and habitats of conservation interest, and evaluating existing threats to the site.

Subsequent field investigations, followed floristic inventories, with species identification in situ and supplemented by herbarium specimens when necessary. Vegetation structure and composition were analyzed using relevé sampling, with plots placed across different microhabitats to ensure comprehensive coverage of the site's peatland, wet meadows, and transition zones.

A DJI Mini 2 drone was used to capture aerial imagery to assess specific habitat distribution, which was then integrated with ground-based botanical surveys.

Field campaigns were carried out in multiple phases to capture the seasonal dynamics of the vegetation. The botanical data collection was conducted between March-November 2022-2023 and January-April 2024, ensuring a comprehensive inventory of plant diversity across different phenological stages.

Additionally, plant material was collected to establish an herbarium collection deposited in the BUCA Herbarium, preserving a reference for future studies. Plant species were identified in the field using the botanical identification key provided by Sârbu et al. (2013). The plant nomenclature for the listed taxa follows the classification established by Flora Europaea and updated through Euro+Med PlantBase, which provides the latest information on species present in the European and Mediterranean regions. For *B. humilis*, the GPS coordinates of each individual shrub were recorded to track population size and spatial distribution.

The phytosociological nomenclature is based on comprehensive syntheses of Romania's vegetation (Sanda et al., 2008; Doniță et al., 2005). Habitat assessments were also performed according to EU Habitats Directive classification, evaluating conservation status and potential threats.

Regarding butterfly fauna, field investigations were carried out on-site, usually in May, at the beginning of the *L. helle* adult flight season. Surveys involved direct visual observation, transect counts, and photographic documentation, with GPS coordinates recorded for each observation. Butterfly species were identified in the field using identification keys (Tolman & Lewington, 2008; Rákosy, 2024).

Data on bird diversity was gathered using the point counts method (Bibby et al., 1992).

RESULTS AND DISCUSSIONS

Challenges of a glacial relict plant in the Anthropocene world

The last glaciation significantly reshaped Europe's vegetation, forcing many species to retreat into refugia, where they could survive in colder and wetter conditions. *B. humilis* (Figure 2) has a long evolutionary history in Europe, multiple lines of evidence suggesting that it survived the Last Glacial Maximum (LGM) in periglacial wetland habitats at higher latitudes. Fossil and pollen records confirm its presence in Germany, Ukraine, and Hungary in Weichselian cold-stage environments (Jadwiszczak et al., 2012).

Figure 2. *Betula humilis* shoot in early vegetative stage, showing young leaves and developing catkins. Photo taken at the Mestecănașul de la Coșna site (Suceava County), June 2023

Unlike other *Betula* species that expanded from Southern European refugia, genetic analyses reveal that *B. humilis* persisted in northern periglacial zones before recolonizing suitable postglacial habitats (Jadwiszczak et al., 2014). Modern relict populations indicate that *B. humilis* had a much broader range in the past, likely extending into both the Alps and the Carpathians during the LGM (Załuski et al., 2001).

In Romania, particularly in the Southeastern Carpathians, peat bogs are not of glacial origin (Pop, 1960). Paleostratigraphic studies (Pop, 1929; Tantau et al., 2003) indicate that glacial-age peat deposits are eutrophic, while the oligotrophic peatlands of today only began forming in the postglacial period. According to these studies, peat bogs in Romania are not a direct result of glaciation but rather of the warmer postglacial climate, which allowed their development. As the climate warmed following the LGM, forests expanded, gradually replacing tundra landscapes. Some of the current glacial relict species found in these peat bogs, including *B. humilis*, originally thrived in tundra-like landscapes or cold, acidic mires with *Pinus sylvestris* (Pop, 1960; Szatmari & Hurdu, 2022). As their original habitats disappeared or transformed, *B. humilis* is now restricted to scattered peat bogs and fens, which became their last refugia. These habitats provide stable conditions for millennia, allowing the species to persist despite climate fluctuations. However, in the Anthropocene, these refuges are increasingly threatened by habitat fragmentation, drainage, and climate change.

The presence of *Betula humilis* in the Coșna area was first recorded by the geologist László (1915). Later, Pop (1928) visited the site in August 1927 and described the entire region as a once-extensive peatland, now severely degraded due to drainage by locals aiming to convert the area into hay meadows. He noted that only three remnants of the original bog persisted, located on the left side of the Teșna stream, between the Jinu stream and the parish house. In these areas, *B. humilis* still grew abundantly, together with *Salix repens* subsp. *rosmarinifolia*, including along the edges of drainage ditches and in repeatedly mown meadows, where it had resisted extirpation. By 1960, however, he observed that the peatland behind the Coșna school no longer resembled a typical bog, lacking the characteristic *Pinus sylvestris* cover seen in other regional sites. Instead, livestock grazing had severely impacted it, with vegetation degraded.

Peterschilka (1928) also surveyed the area, reporting *B. humilis* in the "Putredu" bog (Pilugani) and as a dominant species within the meadow complexes underlain by peat substrates in the Coșna region.

Infrastructural development further impacted the habitat: the construction of the Ilva Mică-Vatra Dornei railway, which traverses the Teșna Valley, began in 1923 and caused substantial alteration of the local landscape. Although severely damaged during World War II, the railway was rebuilt and reopened in 1947 (Botez, 1977). The region was also affected by the later construction and expansion of County Road DJ 172D, which cuts through the Coșna peatland and contributed to fragmentation and hydrological disruption. Combined with increased housing development and the need to extend grazing areas, these pressures led to further drainage and habitat loss, shrinking what was once a large, continuous bog complex.

Although the Tinovul Mare Coșna Natura 2000 site was designated as a protected area in 2017, comprising two bog fragments, one near Coșna and another in Românești, *B. humilis* was no longer present at the time of designation and is not included in the site's management plan (Anonymus, 2015). Currently, the only known surviving population of *B. humilis* in Bukovina is found within the proposed nature reserve "Mestecănașul de la Coșna". The present-day fragmented nature of the peatland meadows is a remnant of a once-continuous wetland ecosystem that formerly covered much of the Teșna Valley. According to elderly locals from Coșna, the original peatland ("Tinovul cel Mare de la Coșna") was much larger, estimated at over 50 ha. Although only isolated patches of peatland remain today, locals still refer to non-forested areas as "tinov", reflecting the past extent of this ecosystem.

Present vegetation structure

The "Mestecănașul de la Coșna" peatland is a complex wetland mosaic consisting of wet meadows, pastures, eutrophic marshes, and oligotrophic bogs, with patches of pine-

dominated bog woodland characteristic of the Dorna Basin peatlands (Figure 3).
The vegetation of the site was partially documented in a previous study focusing on the rediscovery of conservation concern *Lycaena helle* (Ion et al., 2023), particularly describing the specific habitats used by this butterfly.

Figure 3. Aerial view of the proposed Natura 2000 site Mestecănașul de la Coșna and the *B. humilis* Reserve

The local nature reserve is located in the eastern part of the proposed Natura 2000 site, while the *B. humilis* population is concentrated in the central sector of the designated reserve area. A total of 55 individuals were recorded and are represented in the distribution map (Figure 4).
The spatial aggregation of individuals indicates a relatively compact population reflecting a reduced suitable microhabitat following past land-use changes and hydrological alterations.

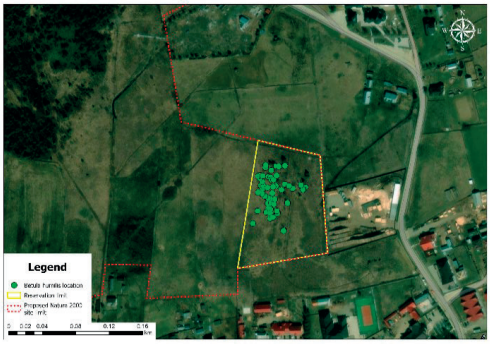

Figure 4. Location of the individuals of *B. humilis* (green circles) in Mestecănașul de la Coșna proposed local reservation

The aspect of the area is characterized by an open wetland with scattered individuals of *Picea abies*, *Betula pendula*, *Frangula alnus*, and *Salix caprea*, interspersed with dense shrub formations dominated by *B. humilis* and *Salix repens* subsp. *rosmarinifolia* (Figure 5). The herbaceous layer is structurally diverse and floristically rich and includes species such as *Bistorta officinalis*, *Filipendula ulmaria*, *Comarum palustre*, *Cirsium rivulare*, *Dryopteris cristata*, *Epilobium palustre*, *Valeriana officinalis*, *Equisetum palustre*, *Crepis paludosa* and *Rumex acetosa, Galium palustre*, *Caltha palustris*, *Plantago lanceolata*, *Potentilla erecta*, *Viola declinata*, *Galeopsis speciosa*, *Cardamine pratensis*, *Agrostis canina*, *Campanula abietina*, *Carex diandra*, and *Vaccinium oxycoccos*.

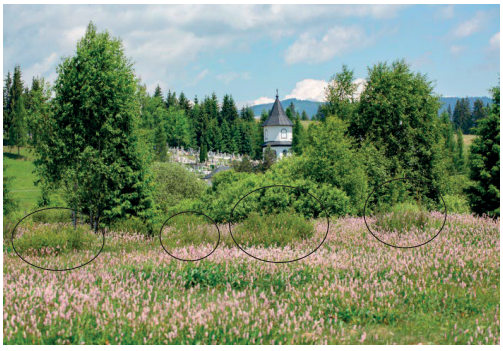

Figure 5. *B. humilis* shrubs (marked with circles) growing in a wet meadow habitat within the Mestecănașul de la Coșna site

Several species recorded within this herbaceous community are of conservation interest. *Comarum palustre* is listed as vulnerable in the Romanian flora (Dihoru & Dihoru, 1994), while *Dryopteris cristata* is classified as vulnerable and rare (Dihoru & Dihoru, 1994; Oltean et al., 1994). *Vaccinium oxycoccos* (Figure 7 c) is considered endangered (Witkowski, 2003) and rare at the national level (Oltean et al., 1994; Dihoru & Dihoru, 1994). *Salix repens* subsp. *rosmarinifolia* (Figure 7 d), a characteristic element of oligotrophic wetlands, is also regarded as rare (Oltean et al., 1994). Additionally, the presence of *Dactylorhiza majalis* (Figure 7 b), a rare orchid species in Romania (Oltean et al., 1994; Dihoru & Dihoru, 1994), further underlines the botanical significance of the site.
The reserve's eastern edge borders a local timber depot, which poses potential ecological pressures through edge disturbance and changes

in hydrology, highlighting the need for buffer zones.

In the northern section of the site, a bog woodland community is clearly delineated, corresponding to the *Vaccinio-Pinetum sylvestris* Kleist 1929 em. Matuszk. 1962 association. This habitat has been identified as 91D0* (*Bog woodland*) under the EU Habitats Directive, a priority habitat type that plays a crucial role in maintaining peatland biodiversity. It occupies approximately 17% of the total site area and is characterized by a species-poor composition due to the oligotrophic conditions of the wetland.

The tree layer is dominated by *Pinus sylvestris*, with scattered occurrences of *Betula pendula* Roth, *Sorbus aucuparia*, and *Rhamnus frangula*, contributing to a total canopy cover ranging from 50% to 70%. The pines are typically stunted, reaching a maximum height of 3–4 meters, and are frequently covered with lichens. Beneath the canopy, the shrub layer is sparsely developed, consisting mainly of juvenile *Pinus sylvestris*, along with occasional individuals of *B. pendula* and *B. humilis*. The herbaceous and dwarf shrub layer is well represented, with *Vaccinium vitis-idaea* being dominant, alongside *Vaccinium myrtillus*, *Vaccinium oxycoccos*, and *Eriophorum vaginatum*. In areas where the tree layer is less developed, this vegetation achieves a high degree of coverage, ranging from 70% to 80%.

The moss layer is highly developed, forming a dense carpet dominated by *Sphagnum* species: *Sphagnum angustifolium* (Russow) C.E.O. Jensen, *Sphagnum capillifolium* (Ehrh.) Hedw. *Sphagnum divinum* Flatberg & K. Hassel, *Sphagnum medium* Limpr. At the margins of the bog woodland, where groundwater infiltration is more pronounced, additional species such as *Salix repens* subsp. *rosmarinifolia*, *Salix caprea*, *Rhamnus frangula* and *Carex brizoides* in the ground layer become more frequent.

The area at the margins of the forested bog, represents a transition zone between the wooded peatland and open wet meadows. The site lacks mature trees, with only a few scattered saplings of *Picea abies, Salix capraea* and isolated occurrences of *B. humilis*. The surface is characterized by numerous hummocks, which create a microtopographic mosaic that influences plant distribution. *Vaccinium oxycoccos* is abundant on the elevated hummocks, sometimes accompanied by *Andromeda polifolia*. The latter is considered endangered in the Carpathians (Witkowski, 2003) and rare at the national level (Oltean et al., 1994; Dihoru & Dihoru, 1994).

The natural mesophilic meadows (Figure 6) are covering approximately one-quarter of the site's surface, forming a distinct vegetation complex within the *Molinio-Arrhenatheretea* class. These fenced and ungrazed meadows are characterized by a dense and compact herbaceous layer, 80-90% coverage.

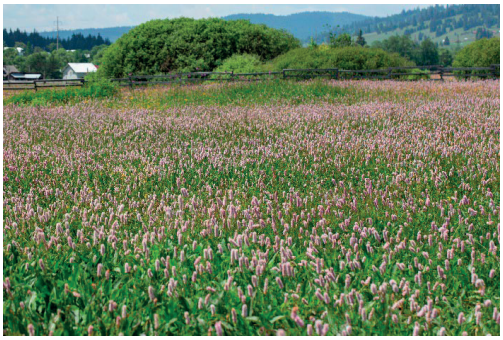

Figure 6. Mesophilic meadows dominated by *Bistorta officinalis*

The floristic composition is characterized by the dominance of *Bistorta officinalis*, along with other hygrophilous species, such as *Rumex acetosa, Cirsium rivulare, Ranunculus repens, R. acris, Succisa pratensis, Epilobium palustre, Veronica chamaedrys, Equisetum palustre, Poa palustris, Crepis paludosa*, *Cardamine pratensis*, *Geum rivale*, interspersed with scattered shrubs of *Salix caprea*.

In the north-eastern extremity of the protected area, the vegetation is characterized by a hygrophilous meadow community comprise by *Carex rostrata*, *Carex acutiformis*, *Ranunculus acris*, *Mentha longifolia*, *Cirsium palustre*, *Lysimachia vulgaris*, *Agrostis capillaris*, *Anthoxanthum odoratum*, *Phleum pratense*, *Briza media*, *Molinia caerulea*, *Lathyrus pratensis*, *Equisetum palustre*, *Euphrasia* sp., *Angelica sylvestris*, *Rumex acetosa*, *Parnassia palustris*, and scattered *Salix capraea* shrubs.

Within this meadow, a population of *Ligularia sibirica* was identified (Figure 7 a), consisting of approximately 70 individuals - 55 of which were recorded in a fruiting state at the time of the field

investigation and around 15 in a vegetative state. *Ligularia sibirica* is a rare glacial relict species of significant conservation value, listed in Annex II of the EU Habitats Directive (92/43/EEC) as a species of community interest requiring the designation of Special Areas of Conservation, and under Appendix I of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). It is also classified as Critically Endangered (CR) in the Carpathians (Witkowski, 2003), Data Deficient (DD) on the IUCN Red List (Bernhardt et al., 2025), and Rare (R) in the Romanian flora (Oltean et al., 1994; Dihoru & Dihoru, 1994).

Figure 7. Rare and protected plant species characteristic of the peatland habitat at Mestecănașul de la Coșna: *Ligularia sibirica* (a); *Dactylorhiza majalis* (b); *Vaccinium oxyccocos* (c); *Salix repens* subsp. *rosmarinifolia* (d)

Its presence further emphasizes the ecological significance of the proposed protected area and highlights the necessity for effective conservation and habitat management measures.

The entire area is intersected by several drainage ditches, excavated to remove the excess water and convert it into pasture. Some of these channels are deep and well-defined, supporting characteristic hygrophilous vegetation, including *Typha angustifolia, Carex rostrata,* and *Carex nigra, Mentha aquatica, Caltha palustris.* An aquatic plant community is established in sections where water depth exceeds 40-50 cm, dominated by *Potamogeton natans, Callitriche palustris* and rare *Menyanthes trifoliata* (Dihoru & Dihoru, 1994; Oltean et al., 1994).

Aspects of local fauna

In addition to its botanical relevance, the proposed area for the Natura 200 site, in particularly the mesophilic meadows, plays a crucial role in maintaining a viable population of the Violet Copper butterfly *Lycaena helle* (Denis & Schiffermüller, 1775), a species of community interest listed in the Habitats Directive (92/43/EEC).

Lycaena helle (Figure 8) is a glacial relict with a Eurosiberian range, generally associated with the habitat types identified at Coșna. In Europe, it occurs from 0 to 2000 m a.s.l., inhabiting wetlands such as fens, *Sphagnum* bogs, wet meadows, swampy fallow lands, wet tussocky grasslands, as well as woodlands and forests (Tolman & Lewington, 2008). However, while the known populations in Romania live in clearings in oak woods (Craioveanu et al., 2014; Rákosy, 2024), the population in Coșna prefers open semi-natural habitats and meadows, moving towards the bog woodland but seldom venturing into the forest.

Figure 8. *Lycaena helle* feeding on a *Cardamine pratensis* flower in the wet meadows of Mestecănașul de la Coșna site

The larva of *L. helle* develops and feeds exclusively on the leaves of *Bistorta officinalis* Delarbre (Rákosy, 2024). Meanwhile, the adults

have a more varied diet, primarily feeding on *B. officinalis* in the first generation of lowland Romanian populations (Craioveanu et al., 2014). Additionally, they feed on nectar from *Myosotis* sp., *Cardamine pratensis*, *Anemone nemorosa*, *Ranunculus acris*, *Ligustrum vulgare*, *Mentha longifolia*, and *Eupatorium cannabinum*. In contrast, at Coșna, where *B. officinalis* is not in bloom in May, the fresh adults primarily feed on *Cardamine pratensis*, and occasionally on *Ranunculus acris*, *R. repens*, and *Viola sp.* (Ion et al., 2023).

In the Romanian Red Book of Invertebrates, this species is classified as Endangered, approaching Critically Endangered (Rákosy, 2021), primarily due to the loss of lowland populations. The population from Coșna, located at a higher altitude and surrounded by rapidly growing human settlements, is of particular conservation and scientific interest, further highlighting the necessity of legal protection for its habitat.

The conservation of these wet meadows is therefore, crucial for maintaining both habitat integrity and the persistence of *L. helle* populations within the site.

During the field studies in the perimeter of the proposed Natura 2000 site we identified five species of amphibians: the Carpathia newt (*Lissotriton montandoni*), the alpine newt (*Ichthyosaura alpestris*), the yellow-bellied toad (*Bombina variegata*), the common toad (*Bufo bufo*), and the common frog (*Rana temporaria*), and one species of reptile – the European adder (*Vipera berus*). All species of amphibians and reptiles identified are protected by national and European legislation. The Carpathian newt and the yellow-bellied toad are listed in Annex II of the Habitats Directive. Moreover, the Carpathian newt is endemic to the Carpathian Mountains; in Romania it is locally abundant, but its distribution is restricted to the Eastern Carpathians and parts of the Southern Carpathians. The proposed site is used by the species for breeding (where it takes advantage of the temporary and permanent water puddles), as well as for feeding and hibernation during the terrestrial phase.

In terms of bird diversity, the area seems to cater for several species. We recorded the presence of members belonging to 7 families represented through 16 species, out of which 5 are of community interest: 2 listed on Anex I of the Birds Directive (Birds Directive, 2009) (*Anthus campestris*, *Lanius collurio*) and 3 taxa included on the National Red List of Birds Species (MMAP, 2022) (*Carpodacus erythrinus*, *Linaria cannabina*, *Saxicola rubetra*). Best represented groups were *Fringillidae, Motacillidae, Muscicapidae and Sylviidae*, with species that generally thrive in this type of habitats (e.g. *Motacilla alba*, *Motacilla cinerea*, *Sylvia borin*, *Fringilla coelebs*). Considering site size and the surrounding area's landscape, the recorded avian diversity highlights that this mire acts as an effective stepping stone, aiding species regional and long-distance dispersal, thus playing an important role during migrations.

Restoration and awareness actions undertaken

B. humilis along with other wet meadows specialist depends on stable hydrological conditions making its populations highly vulnerable to habitat drainage and anthropogenic alterations (Dihoru & Negrean, 2009).

In this respect, several on-site interventions were implemented to restore and protect the ecological integrity of the Coșna peatland. These included blocking drainage channels to restore the water regime, installing informational panels at site access points for promoting environmental education, and fencing sensitive areas to prevent grazing and allow for natural vegetation regeneration.

Engaging local stakeholders has played a central role in the restoration process. The Institute of Biology Bucharest team facilitated activities aimed at raising awareness about the ecological importance of the site. These initiatives involved the dissemination of educational materials, engagement with local entrepreneurs to highlight the potential of ecotourism, and educational presentations on local flora and fauna delivered in schools. Field trips to the peatland were also organized, offering students hands-on experience in wetland biodiversity monitoring alongside conservation specialists.

A key outcome of the partnership with the Coșna Local Council was initiating the formal procedure to designate the peatland behind the Coșna school as a locally protected area. This step ensures long-term conservation of the site and its valuable habitats and species.

Ex situ conservation of *B. humilis*

B. humilis is currently cultivated in the "Al. Borza" Botanical Garden, Cluj-Napoca, and the "V. Fati" Botanical Garden, Jibou (Hurdu et al., 2022). Additionally, under the PeatRO 2 project, as part of the ex-situ conservation program targeting peatland plant species, seeds were collected to establish collections for ex situ conservation and to support future reintroduction initiatives.

CONCLUSIONS

"Mestecănașul de la Coșna" site in Bukovina stands out as a unique ecological refuge for one of Romania's largest populations of *Betula humilis* Schrank, a glacial relict, together with other species of European conservation interest such as *Ligularia sibirica* and *Lycaena helle*. Although it has suffered from anthropic interference, significantly reducing the overall surface, this peatland still has a high biodiversity value. The conservation of *B. humilis* acts as an umbrella for the other rare and vulnerable species, sharing the same ecological conditions of this very specific habitat, that is already severely reduced at European and national level. The site is also home to a diverse community of amphibians, reptiles, and bird species, several of which are protected under EU legislation. Initial restoration efforts, including hydrological rehabilitation, control of invasive species, local education and awareness initiatives, have contributed to the ecological stabilization of the area. Continuous ecological monitoring, strict protective measures, and adaptive management focused on maintaining hydrological balance and minimizing human impact are essential to ensure the long-term conservation of this ecosystem. The proposed designation of "Mestecănașul de la Coșna" as a Natura 2000 site would not only safeguard *B. humilis*, but also demonstrate a broader commitment to protecting peatland ecosystems within the Eastern Carpathians.

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REFERENCES

Austin, K.G., Elsen, P.R., Coronado, E.N.H., DeGemmis, A., Gallego-Sala, A.V., Harris, L., Kretser, H.E., Melton, J.R., Murdiyarso, D., Sasmito, S.D. & Swails, E. (2025). Mismatch between global importance of peatlands and the extent of their protection. *Conservation Letters*, *18*(1), p.e13080. Retrieved from https://conbio.onlinelibrary.wiley.com/doi/epdf/10.1111/conl.13080

Anomynus (2015). Planul de management al sitului ROSCI0245 Tinovul de la Românești. Retrieved from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://mmediu.ro/app/webroot/uploads/files/2015-11-05_PM_Tinovul_de_la_Romanesti.pdf

Bonn, A., Allott, T., Evans, M., Joosten, H., & Stoneman, R. (2016). Peatland restoration and ecosystem services: an introduction. *Peatland restoration and ecosystem services: Science, policy and practice*, 1-16. Retrieved from https://doi.org/10.1017/CBO9781139177788

Boșcaiu, N., Coldea, G. & Horeanu, C. (1994). Lista Roșie a plantelor vasculare dispărute, periclitate, vulnerabile și rare din Flora României. *Ocrotirea Naturii și a Mediului Înconjurător, 38*, 45–56.

Botez, C. (1977). *Epopeea feroviară românească*, Editura Sport–Turism, București.

Bibby, C. J., Burgess, N. D., & Hill, D. A. (1992). Bird Census Techniques. Cambridge: Cambridge Univ. Press. Retrieved from https://www.ebcc.info/wp-content/uploads/2020/06/gregory-bird-census-and-survey-techniques.pdf

Birds Directive (BD) (2009). Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (codified version). Official Journal of the European Union, L20, 7–25. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0147

Chrzanowska A., Jadwiszczak K.A., Kłosowski S., Banaszek A. & Sozinov O.V. (2016) Sexual reproduction efciency and genetic diversity of endangered *Betula humilis* Schrk. populations from edge and sub-central parts of its range. *Folia Geobotanica*, 51: 161–173. Retreive from https://doi.org/10.1007/s12224-016-9244-1

Ciocârlan, V. (2009). *Flora ilustrată a României*. Editura Ceres, București, 1141 p.

Convention on Biological Diversity (CBD) (2022). Kunming-Montreal Global Biodiversity Framework. United Nations Environment Programme (UNEP). Retreive from https://www.unep.org/resources/kunming-montreal-global-biodiversity-framework (Accessed: March 2025)

Craioveanu, C., Sitar, C., & Rákosy, L. (2014). Mobility, behaviour and phenology of the Violet Copper *Lycaena helle* in North-Western Romania:

Implications for conservation. In J. C. Habel, M. Meyer, & T. Schmitt (Eds.), *Jewels in the mist: A biological synopsis on the endangered butterfly Lycaena helle* (pp. 150). Pensoft. Retrieved from https://bit.ly/4iLQhd0

Dihoru, G. & Dihoru, A. (1994). Plante rare, periclitate și endemice în flora României - Lista Roșie. *Acta Horti Botanici Bucurestiensis, 23*, 173–197.

Dihoru, G. & Negrean, G. (2009). *Cartea roșie a plantelor vasculare din România*. Editura Academiei Române. București.

Doniță, N., Popescu, A., Paucă-Comănescu, M., Mihăilescu, S. & Biriș, I.A. (2005). *Habitatele din România*. Editura Tehnică Silvică, București.

European Commission (2020). EU Biodiversity Strategy for 2030: Bringing nature back into our lives. Brussels: European Commission. Retreive from https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en

Euro+Med (2006). Euro+Med PlantBase - the information resource for Euro- Mediterranean plant diversity. Retrieved from http://ww2.bgbm.org/EuroPlusMed/. Accessed February, 2025.

Georgescu, C.C. (1952). Betulaceae. In: T. Săvulescu (Ed.), *Flora Republicii Populare Române*, I, (pp. 189-210), Editura Academiei Republicii Populare Române.

Goia, I. & Fărcaș, S. (1997). Mlaștinile de turbă – impact antropic, conservare și reconstrucție ecologică. *Studii și Cercetări, Științe ale Naturii Bistrița*, 3. 283-289.

Habitats Directive (1992). Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal of the European Communities, L206, 7–50. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31992L0043

Harenda, K.M., Lamentowicz, M., Samson, M. & Chojnicki, B.H. (2018). The Role of Peatlands and Their Carbon Storage Function in the Context of Climate Change. In: Zielinski, T., Sagan, I., Surosz, W. (eds) Interdisciplinary Approaches for Sustainable Development Goals. GeoPlanet: Earth and Planetary Sciences. Springer, Cham. Retreive from https://doi.org/10.1007/978-3-319-71788-3_12

Hurdu, B.I., Coste, A., Halmagyi, A., Szatmari, P.M., Farkas, A., Pușcaș, M., Turtureanu, P.D., Roșca-Casian, O., Tănase, C., Oprea, A. and Mardari, C., (2022). Ex situ conservation of plant diversity in Romania: A synthesis of threatened and endemic taxa. *Journal for Nature Conservation*, *68*, p.126211. Retrieved from https://ui.adsabs.harvard.edu/link_gateway/2022JNatC..6826211H/doi:10.1016/j.jnc.2022.126211

Ion, M.C., Manu, M., Stănescu, M., Maican, S., Helepciuc, F.E., Moroșanu, A.M., Ștefănuț, M.M., Bîrsan, C.C., Tamas, G., Nicoară, R.G. & Ștefănuț, S., (2023). The rediscovery of *Lycaena helle* (Lepidoptera: Lycaenidae) in Dorna Depression (România), 125 years after its first mention. *Scientific Papers. Series D. Animal Science*, *46*(2): 612-620. Retreive from chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://animalsciencejournal.usamv.ro/pdf/2023/issue_2/Art76.pdf Accessed February, 2025.

Jabłońska, E. (2012). Vegetation with *Betula humilis* in Central Europe. *Phytocoenologia*, 42: 259–277. Retreive from https://doi.org/10.1127/ 0340-269X/2012/0042-0527

Jadwiszczak, K.A., Banaszek, A., Jabłońska, E. & Sozinov, O.V. (2012). Chloroplast DNA variation of *Betula humilis* Schrk. in Poland and Belarus. *Tree Genetics & Genomes*, 8, 1017-1030. Retreive from https://doi.org/10.1007/s11295-012-0482-y

Jadwiszczak, K. A., Banaszek, A., Chrzanowska, A., Kłosowski, S., & Sozinov, O. V. (2014). The admixture zone of *Betula humilis* Schrk. phylogenetic lineages follows the eastern central European suture zone. *Plant Ecology & Diversity*, *8*(3), 323–329. Retreive from https://doi.org/10.1080/17550874.2014.893593

Kaplan, Z. (2017). Flora and phytogeography of the Czech Republic. *Flora and vegetation of the Czech Republic*, 89-163.

Joosten, H. & Clarke, D. (2002). Wise use of mires and peatlands: Background and principles including a framework for decision making; International Mire Conservation Group/International Peat Society Saarijärvi, Finland.

Joosten, H. & Tanneberger, F., & Moen, A. (2017). Mires and peatlands of Europe: Status, distribution and conservation. Schweizerbart Science Publishers.

László, G. (1915). *A tőzeglápok és előfordulásuk Magyarországon* [Peat bogs and their distribution in Hungary]. A.M.K. Földtani Intézet Kiadványai.

Leifeld, J., Menichetti, L. (2018). The underappreciated potential of peatlands in global climate change mitigation strategies. *Nature Communication,* 9, 1071. Retreive from https://doi.org/10.1038/s41467-018-03406-6

Limpens, J., Berendse, F., Blodau, C., Canadell, J. G., Freeman, C., Holden, J., ... & Schaepman-Strub, G. (2008). Peatlands and the carbon cycle: from local processes to global implications–a synthesis. *Biogeosciences*, *5*(5), 1475-1491.

Ministerul Mediului, Apelor și Pădurilor (MMAP). (2022). *Lista roșie națională a speciilor de păsări din România* (Monitorul Oficial al României, Partea I, nr. 798 bis/11.VIII.2022). București. Retreive from https://www.sor.ro/wp-content/uploads/1991/01/Lista-Rosie-Monitorul-Oficial-Partea-I-nr.-798Bis.pdf

Oltean, M., Negrean, G., Popescu, A., Roman, N., Dihoru, G., Sanda, V. & Mihăilescu, S. (1994). Lista roșie a plantelor superioare din România. In: Oltean M. (coord.), *Studii, sinteze, documentații de ecologie. Academia România, Institutul de Biologie București,* 1, 1-52. Retreive from https://www.researchgate.net/publication/318654406_Lista_rosie_a_plantelor_superioare_din_Romania

Oprea, A. (2005). *Lista critică a plantelor vasculare din România*. Ed. Univ. Alexandru Ioan Cuza, Iași.

Peterschilka, F. 1928. Pollenanalyse einiger Hochmoore Neurumäniens 80 (Vorläufi ge Mitteilung). *Ber. Dtsch. Bot. Ges., 46*(3), 190-197.

Pop, E. (1928). *Betula nana* L. şi *Betula humilis* Schrank în România. *Buletinul Grădinii Botanice şi a Muzeului Botanic Cluj*, *7*(1), 1-9.

Pop, E. (1929). Analize de polen în turba Carpaților Orientali (Dorna-Lucina). *Buletinul Grădinii Botanice şi a Muzeului Botanic Cluj, 9*(3-4), 81-209.

Pop, E. (1960). Mlaștinile de turbă din R.P.R. Editura Academiei R.P.R.

Pop, E. (1976). Specii relicte în flora României. In T. Săvulescu (Ed.), *Flora Republicii Populare Române*, XIII, 106-111. Editura Academiei Republicii Populare Române.

Pop, A. M., Hognogi, G. G., & Bătinaș, R. H. (2025). Who's voice counts? Managing conservation and sustainable valorisation of peatlands. *Environmental Sciences Europe*, 37(1), 1-19. Retreive from https://doi.org/10.1186/s12302-025-01087-9

POWO (2025). Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Retreive from https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:295106-1 (accessed on March 2025).

Pricop, E., Filip, P.N. and Negrea, B.M. (2019). Floristic study of a protected wetland from Borsaros-Sâncraieni, Harghita County, Romania. *Advances in Agriculture & Botanics*, 11(2), 97-108. Retreive from https://www.proquest.com/docview/2395873816?pq-origsite=gscholar&fromopenview=true&sourcetype=Scholarly%20Journals

Rákosy, L. (2021). *Lycaena helle*. In D. Murariu & S. Maican (Eds.), *The Red Book of Invertebrates of Romania* (p. 318). Romanian Academy Publishing House, Bucharest.

Rákosy, L. (2024). *A field guide to the butterflies of Romania*. Exeter, UK: Pelagic Publishing.

Sanda, V., Ölerrer, K., & Burescu, P. (2008). *Fitocenozele din România*. Bucharest, RO: Ars Docendi Publishing House

Sârbu I., Ştefan N. & Oprea A. (2013): *Plante vasculare din România. Determinator ilustrat de teren*. Victor B Victor, București.

Shaw, K., Roy, S., Wilson, B. (2014). *Betula humilis*. *The IUCN Red List of Threatened Species*. Retreive from e.T194645A2355398. https://dx.doi.org/10.2305/IUCN.UK.2014-.RLTS.T194645A2355398.en.

Swindles, G. T., Morris, P. J., Mullan, D. J., Payne, R. J., Roland, T. P., Amesbury, M. J., ... & Warner, B. (2019). Widespread drying of European peatlands in recent centuries. *Nature Geoscience*, *12*(11), 922-928. Retreive from https://doi.org/10.1038/s41561-019-0462-z

Szatmari, P.M. & Hurdu, B.I. (2022). Low altitude glacial relicts in the Romanian flora. *Contributii Botanice*, (57), 19-51. Retreive from DOI: 10.24193/Contrib.Bot.57.2

Tanneberger, F., Tegetmeyer, C., Busse, S., Barthelmes, A., Shumka, S., Mariné, A. M., . . . Joosten H. (2017). The peatland map of Europe. *Mires and Peat*, *19*(22), 1–17. Retreive from https://doi.org/10.19189/MaP.2016.OMB.264

Tanneberger, F., Moen, A., Barthelmes, A., Lewis, E., Miles, L., Sirin, A., Tegetmeyer, C., Joosten, H. (2021) Mires in Europe-regional diversity. Mires in Europe - Regional diversity, condition and protection. *Diversity*, *13*(8), 381 Retreive from https://doi.org/10.3390/d13080381

Tantau, I., Reille, M., de Beaulieu, J. L., Farcas, S., Goslar, T., & Paterne, M. (2003). Vegetation history in the Eastern Romanian Carpathians: pollen analysis of two sequences from the Mohoș crater. *Vegetation History and Archaeobotany*, *12*, 113-125.

Tolman, T., & Lewington, R. (2008). *Collins butterfly guide: The most complete field guide to the butterflies of Britain and Europe* (384 pp). Harper Collins Publishers.

UNEP (2022). Global Peatlands Assessment–The State of the World's Peatlands: Evidence for action toward the conservation, restoration, and sustainable management of peatlands. *Main Report. Global Peatlands Initiative*.

Verhoeven, J. T. (2014). Wetlands in Europe: perspectives for restoration of a lost paradise. *Ecological Engineering*, *66*, 6-9. Retreive from https://doi.org/10.1016/j.ecoleng.2013.03.006

Witkowski, Z. J., Król, W., Solarz, W. (2003). *Carpathian List of Endangered Species*. Vienna-Krakow: WWF and Institute of Nature Conservation, Polish Academy of Sciences.

Załuski, T., Pisarek, W., & Kucharczyk, M. (2001). *Betula humilis* Schrank. In: Kaźmierczakowa R., Zarzycki K. (eds.), *Polish Plant Red Data Book*, Polish Academy of Sciences, Kraków.