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THE DEGREE OF THE ROOTING AND ADAPTABILITY OF CORMOFLORA ON THE WASTE DUMPS OF THE BAIA NOUĂ QUARRY (MEHEDINȚI COUNTY)

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Abstract

The studied area includes the former Baia Nouă quarry mining, which belongs to the Dubova locality, Mehedinți County, an integral part of the Banat Mountains. As part of this work, we tried to carry out an ecological rehabilitation study of the area where all mining operations have been closed for a very long time, the Baia Nouă quarry mining is a ruin, here you can find waste and garbage resulting from the abandonment and degradation of the administrative buildings in the quarry. In order to achieve a good rehabilitation of this area, we took into account the type of native vegetation, existing here and in the immediate vicinity, in order to avoid fragmentation of habitats, as well as the existence of an obvious "desire" of some species to establish themselves and conquer new territories in this area.

***Key words**: Baia Nouă, quarry, waste dumps, adaptability, cormoflora.*

INTRODUCTION

Mining activity was known and practised worldwide since ancient times. Human impact exerted in a mining career on biodiversity is smaller or greater and it depends on many factors (Niculescu, 2019). Mining environment issues require a systematic approach and sustainable environmental management techniques must be applied correctly in the mining areas around the world. It is very important to establish principles and strategic elements to ensure sustainable development in a mining quarry. For good ecological rehabilitation in a mining quarry, we must first know the biodiversity existing in that area in all its complexity, including the substrate on which it grows (Niculescu, 2019).

Following mining operations, the so-called mining dumps are formed, consisting of the waste material brought to the surface from underground galleries, which over time require the restoration of the land to useful destinations from an ecological, economic and social point of view through a process of improving the natural capital in the mining pits (Niculescu, 2015).

The ecological rehabilitation of degraded lands and the establishment of a vegetal carpet on waste dumps also play an important role in stabilizing and "greening" these dumps, consolidating the resulting coarse deposits, and restoring the natural landscapes of a mining area.

The restoration of biodiversity from a mining quarry, on the dumps left after exploitation, is indispensable, regardless of where it is located. The studied area includes the former Baia Nouă mine, which belongs to the commune of Dubova, Mehedinți County, an integral part of the Banat Mountains. This area is particularly important from a geographical, floristic and faunal, landscape, cultural and economic point of view, as the "Portile de Fier" Natural Park is located in this area. As part of this work, I tried to carry out an ecological rehabilitation study of the area where all mining operations have been closed for a very long time, the Baia Nouă mine is a ruin, here you can find waste and garbage resulting from the abandonment and degradation of the administrative buildings in the quarry (Figures 1 and 2).

As a result of mining activity in the perimeter of the former Baia Nouă mining pit, an important area has resulted in which the entire biodiversity has suffered. At the same time, there are still waste dumps made up of course materials (gravel, sand), in the form of mounds on which a pioneer vegetation has settled in a continuous expansion and adapted to the current eco-pedo-climatic conditions, as well as with a favourable coenotic and syndamic

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evolution for the restoration of the ecological, bio-conservative balance in the studied area.

The study and knowledge of the degree of restoration and regeneration of the cormoflora and implicitly of the entire biodiversity within the perimeter of the former Baia Nouă mining quarry, where they have undergone profound changes due to anthropo-zoogenic factors resulting both during exploitation and after the quarry's closure, in an area of bioconservative interest, responds to a need of great interest.

Figure 1. The remains of an abandoned building in the Quarry (photo: M. Niculescu)

Figure 2. Aspects of the former constructions of the Baia Nouă Mining Quarry (photo: M. Niculescu)

MATERIALS AND METHODS

Study area

As mentioned, the studied territory is located within the perimeter of the former Baia Nouă mining quarry in the village of the same name belonging to Dubova locality, Mehedinți County, Romania. During the period 2021-2024, studies were carried out in this area that falls between the following geographical coordinates: 44°56′73,4″N-22°11′59,4″E and 44°56′73,1″N -22°11′58,8″E, the altitude being between 523-517 m (using Geo Tracker – GPS traker application).

Geographically, the former mining quarry is located in the Banat Mountains, in a narrow valley of the Tisovița River, bordered by forest vegetation often installed on quite steep slopes, which extends to the mines exploited in Baia Nouă. The Baia Nouă village is located approximately 10 km from the Danube basin, namely the Porțile de Fier Gorge, being an integral part, as we mentioned, of the "Porțile de Fier" Natural Park (Figure 3).

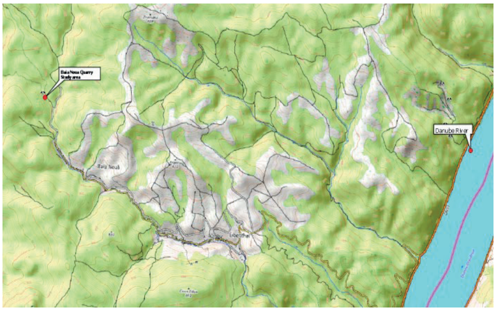

Figure 3. Map of the studied territory - Baia Nouă mining quarry (Mehedinți County)

Floristic and phytosociological analysis

The identification of taxa was based on Illustrated Flora of Romania: *Pteridophyta* and *Spermatophyta* (Ciocârlan, 2000), Romanian Flora (Săvulescu, coord., 1952-1976) and Flora Europaea (Tutin et al., 1964-1980).

For the coenotaxonomic study we used synthesis studies of the following authors Coldea (1991, 1997), Sanda et al. (1997), as well as Oberdorfer (1992), Mucina et al. (1997, 2016), Rodwell (2002).

RESULTS AND DISCUSSIONS

To ensure effective rehabilitation of the area, we considered the native vegetation present locally and in the surrounding vicinity to avoid habitat fragmentation. We also observed the clear tendency of certain species to establish and expand into new territories within the quarry. Field research across the quarry, particularly on the remaining waste heaps, revealed that some plant species exhibited a high degree of rooting ability and adaptability, enabling them to rapidly colonize new areas.

Given these observations, we deemed it essential to conduct a study focusing on these species with high colonization capacity. We classified the identified species based on their rooting ability and adaptability within the former quarry, assigning each species a score from 1 to 10 according to the number of individuals, species ecology, and, most importantly, their rooting, regeneration, and adaptation capacities, as well as the land area occupied (Table 1). These species demonstrated excellent development and vitality on the waste dumps, showing robust growth and successful fruiting without issues. This confirms the area's strong potential for ecological rehabilitation using native species, with natural regeneration holding significant promise. However, realizing this potential requires implementing a green management plan, particularly now that anthropogenic pressures and pollution have decreased following the quarry's closure.

Overall, the conditions within the former quarry are favorable for restoring natural habitats, which can contribute to reducing pollution levels with minimal intervention.

Among the species with notable rooting and regeneration capacities, three are particularly important: *Scleranthus perennis*, *Calamagrostis epigeios*, and *Elymus repens* (syn. *Agropyron repens*).

Scleranthus perennis is a pioneer species that has readily established itself in the area, thriving on skeletal soils.

Calamagrostis epigeios is a perennial species that prefers sandy soils and areas that have experienced disturbance, establishing easily at the base of the dumps or on flat lands surrounding the former constructions of the Baia Nouă mining quarry.

Elymus repens (syn. *Agropyron repens)* is characterized by a broad ecological tolerance, readily colonizing disturbed land surfaces.

A vine species, *Clematis vitalba,* is frequently found within the quarry perimeter, where it is locally dominant as a pioneer species (Figure 4). It primarily establishes on the upper parts of the remaining tailings dumps, occupying significant areas within the study site (Figure 5).

Invasive species have also established within the quarry, with frequent occurrences of *Ambrosia artemisiifolia, Erigeron annuus* (Figure 6), *Galinsoga ciliata,* and *Ailanthus altissima.*

Figure 4. *Clematis vitalba* in the former Baia Nouă mining quarry (photo: M. Niculescu)

Figure 5. *Clematis vitalba* on a waste dump in the former Baia Noua mining quarry (photo: M. Niculescu)

These species demonstrated excellent development and vitality on both soil types, successfully flowering and fruiting without issues. This further confirms the area's strong potential for ecological rehabilitation using native species, with natural regeneration showing great promise. Additionally, anthropogenic pressures and pollution have decreased in intensity within the site.

From a syndynamic perspective, studies indicate that the vegetation on the remaining quarry dumps is progressing towards the establishment of the following plant communities: *Medicagini lupulinae-Agropyretum repentis* Popescu et al. 1980 (Figure 7) and *Medicagini-Festucetum valesiacae* Wagner 1941 (Figure 8).

Figure 6. *Erigeron annuus* in the former Baia Noua mining quarry (photo: M. Niculescu)

The first plant community began to settle in the southern part of the quarry at the base of the dumps, here several phytocoenoses ranging between 10-100 m^2 were observed. The second plant community has settled in the quarry on smaller surfaces, *Medicago minima* as an edifying species frequently occurring alongside *Festuca valesiaca* on stony soils, alongside a well-defined core of species characteristic of this plant community, frequently found in the Tisovița Valley.

Figure 7. *Medicagini lupulinae-Agropyretum repenti s*Popescu et al. 1980 plant community in the former Baia Nouă mining quarry (photo: M. Niculescu)

Figure 8. *Medicagini-Festucetum valesiacae* Wagner 1941 plant community in the former Baia Noua mining quarry (photo: M. Niculescu)

Some species settle at the edge of the forest, next to abandoned buildings in ruins, or within meadow communities with a secondary character, in the floristic structure of ruderal communities, settling on skeletal, on more or less oligotrophic soils, among which we can mention *Teucrium chamaedrys* (Figure 9), *Lysimachia punctata* (Figure 10), *Hypericum perforatum*.

Figure 9. *Teucrium chamaedrys* in the former Baia Nouă mining quarry (photo: M. Niculescu)

Figure 10. *Lysimachia punctata* in the former Baia Nouă mining quarry (photo: M. Niculescu)

Table 1. The degree of the striking root (grip) and adaptability of cormoflora in the Baia-Nouă Quarry

No.	Species	Family	Biologic forms	Phyto-geographic elements	Ecologic gropup: U, T, R (after Zolyomi, 1954)	The degree of the striking root (grip) and adaptability (scal 1-10)
1	*Clematis vitalba* L.	Ranunculaceae	N-E	Ec(Med.)	U3T3R3	10
2	*Calamagrostis epigeios* (L.) Roth.	Poaceae	H (G)	Eua(Med.)	U2T3R0	10
3.	*Scleranthus perennis* L.	Caryphyllaceae	(H) Ch	Eua	U3T0R3	10
4.	*Elymus repens* (L.) Gould (*Agropyron repens* (L.) Beauv.)	Poaceae	G	Cosm	U0T0R0	9
5.	*Medicago lupulina* L.	Fabaceae	TH(H)	Eua	U2,5T3R4	9
6.	*Medicago minima* L.	Fabaceae	Th	Eua(Med.)	U1,5T4R4	8
7.	*Hieracium pilosella L.*	Asteraceae	H	E(Med.)	U2T0R2	8
8.	*Echium vulgare* L.	Boraginaceae	TH	Eua	U2T3R4	7
9.	*Festuca valesiaca* Schleicher ex Gaudin.	Poaceae	H	Eua(Cont.)	U1T5R4	7
10.	*Teucrium chamaedrys* L.	Lamiaceae	Ch	Ec-Med	U2T4R4	7
11.	*Thymus comosus* Heuffel	Lamiaceae	Ch	Carp(End)	U2T3,5R4,5	7
12.	*Potentilla argentea* Borkh.	Rosaceae	H	Eua	U2T4R2	7
13.	*Erigeron annuus* (L.) Pers.	Asteraceae	H	Carp(End)	U4T2R3	7
14.	*Galinsogaciliata* (Rafin.) Blake	Asteraceae	Th	Adv	U2,5T4R3	6
15.	*Melilotus albus* Medik.	Fabaceae	Th-TH	Eua	U2,5T3R0	6
16.	*Tussilago farfara* L.	Asteraceae	G-H	Eua	U3,5T0R4,5	6
17.	*Scabiosa columbaria* L.	Dipsacaceae	H	E (Med.)	U2,5T3R4,5	5
18.	*Salvia nemorosa* L.	Lamiaceae	H	Ec	U2,5T4R5	5
19.	*Artemisia absinthium* L.	Asteraceae	Ch-H	Eua(Med.)	U2T3,5R0	5
20.	*Rubus fruticosus L.* (*R. plicatus* Weihe et Nees)	Rosaceae	N	Atl.-Ec.	U3,5T3,5R2	5
21.	*Dactylis glomerata* L.	Poaceae	H	Eua	U3T0R4	5
22.	*Achillea millefolium* L.	Poaceae	H	Eua	U3T0R0	5
23.	*Robinia pseudoaccacia* L.	Fabaceae	MPh	Adv	U2,5T4R0	5
24.	*Sambucus ebulus* L.	Caprifoliaceae	H	Eua(Med)	U3T3R4,5	5
25.	*Galium verum* L.	Rubiaceae	H	Eua	U2,5T2,5R0	4
26.	*Hypericum perforatum* L.	Hypericaceae	H	Eua	U3T3R0	4
27.	*Ambrosia artemisiifolia* L.	Asteraceae	Th	Adv	U2T0R0	4
28.	*Melica ciliate* L.	Poaceae	H	Ec-Balc	U1,5T4R4	4
29.	*Helianthemum numularia* (L.) Mill.	Cistaceae	Ch-H	Ec(Med)	U2T3R4	3
30.	*Mentha arvensis* L.	Lamiaceae	H-G	Cosm	U3T3R0	3
31.	*Plantago media* L.	Plantaginaceae	H	Eua	U2,5T0R4,5	3
32.	*Plantago lanceolata* L.	Plantaginaceae	H	Eua	U0T0R0	3
33.	*Linaria vulgaris* Mill.	Scrophulariaceae	H (TH)	Eua	U2T3R4	3
34.	*Lotus corniculatus* L.	Fabaceae	H	Eua	U2,5T0R0	2
35.	*Rosa canina* L.	Rosaceae	N	E	U2T3R3	2
36.	*Cichorium intybus* L.	Asteraceae	H-TH	Eua	U2,5T3,5R4,5	2
37.	*Arabis hirsuta* (L.) Scop.	Brassicaceae	TH(H)	Eua (Med.)	U1,5T3R4	2
38.	*Ranunculus repens* L.	Ranunculaceae	H	Eua (Med.)	U4,5T3R0	2
39.	*Trifolium pratense* L.	Fabaceae	H-TH	Eua	U3T0R0	2
40.	*Verbascum nigrum* L.	Scrophulariaceae	TH-H	Eua	U2T3R4	1
41.	*Salvia nemorosa* L.	Lamiaceae	H	Ec	U2,5T4R3	1
42.	*Artemisia vulgaris* L.	Asteraceae	H(Ch)	Cosm	U2,5T3R4	1
43.	*Urtica dioica* L.	Urticaceae	H (G)	Cosm	U3T3R4	1
44.	*Phytolacca americana* L.	Pthytolaccaceae	H	Adv	U2,5T3R4	1
45.	*Chelidonium majus* L.	Papaveraceae	H	Eua	U3T3R4	1
46.	*Papaver rhoeas* L.	Papaveraceae	Th	Cosm	U3T3,5R4	1
47.	*Veronica austriaca* L.	Scrophulariaceae	H	Pont.-Med.-Ec	U2T4R5	1
48.	*Cardaria draba* (L.) Desv.	Brassicaceae	H	Eua (Med)	U2T4R4	1
49.	*Ailanthus altissima* (Miller) Swingle	Simaroubaceae	MPh	Adv.	U0T0R0	1

In Tabel 1 the following abbreviations were used:

- Bioforms: Ch – chamaephytes; MPh – megaphanerophytes; H – hemicryptophytes; N – lianas; Th – annual therophytes; TH – biennial therophytes; Hh – helophytes; G – geophytes.
- Floristic elements: Cosm – cosmopolitan; Adv – adventive; Eua – Eurasian; E – European; Ec – Central European; Atl – Atlantic; Med – Mediterranean; Cont – continental; Pont – Pontic; Pan – Pannonian; End – endemic; Balc – Balkan; Carp – Carpathian.
- Ecological indices: U – humidity; T – temperature; R – soil reaction.

CONCLUSIONS

Mining operations result in the formation of mining dumps, composed of waste material brought to the surface from underground galleries. Over time, these areas require restoration to ecologically, economically, and socially beneficial uses through the improvement of natural capital within mining pits.

The perimeter of the former Baia Nouă mining quarry is characterized by significant Anthropogenic impacts, including waste, abandoned structures, and tailings dumps. However, studies on the bio-ecological rehabilitation of this area have shown that it has gradually undergone natural restoration over several years.

Ruderal vegetation and native plant communities have established on the waste dumps, demonstrating good dynamics and progression. Surveys identified 49 cormophyte species with high capacity and affinity for colonizing and stabilizing these disturbed areas. Among these, several species can form primary or secondary plant communities within the mining landscape.

Two meadow-specific plant communities have developed a well-defined coenotic structure and strong synanthropic relationships, allowing them to expand into larger areas. Given that the study area is part of the "Iron Gates" Natural Park, the restoration of the plant communities *Medicagini-Festucetum valesiacae* Wagner 1941 and *Medicagini lupulinae-Agropyretum repentis* Popescu et al. 1980 holds particular importance for the recovery of natural meadow habitats and the conservation of biodiversity in this region.

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