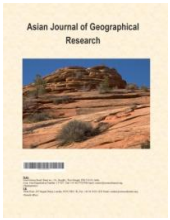

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Global Desert Areas Vs Local Mining Areas from Maramureș County (Romania)

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Authors' contributions

This work was carried out in collaboration between both authors. Author BVC designed the study, performed the statistical analysis, managed the literature searches, and wrote the first draft of the manuscript. Author MC managed the analyses of the study. Both authors read and approved the final manuscript.

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ABSTRACT

Almost a third of the Earth's surface is occupied by vast stretches of stone and sand, having a torrid climate or, on the contrary, extremely frigid. As such, the regions considered to fall into the category of deserts, which can be hot and arid, semi-arid, coastal, or cold, are of interest for the present study. In the same context, at the level of the Maramureș County surface, a major place is occupied by the areas that have served mining activities, and which, at first glance, have similarities with the specific landscapes of deserts. Starting from the aforementioned, through the present work, we intend to underline, in the form of a comparative study, the main common elements that exist between the naturally formed (globally) and anthropic (locally) deserts, for those the latter considering the areas of Maramures County, affected by the specific mining pollution.

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1. INTRODUCTION

Desert is a relatively difficult biome to define. Theoretically, it could be said that it is a water-free living space, but temperate, tropical, Mediterranean, or continental environments may also tend to evolve towards aridity and desertification [1]. From a biological point of view, the desert is a living environment covered with very poor, diffuse vegetation, concentrated more around temporary wetlands (occasional watercourses or lakes), or in exceptional cases, the vegetation may be totally absent. In simplified terms, deserts are dry regions of the planet, where small amounts of precipitation fall (below 100 mm/year) [2].

The deserts are characterized by extensive forms of erosive-cumulative relief, with very intense geomorphological processes, such as disaggregation, corrosion, deflation, torrential erosion, rock collapses, etc. Due to the poorly represented vegetation cover and the very low population density, they are also called "wilderness" [2]. Extremely arid and poor regions in vegetation, deserts occupy almost 1/3 of the Earth's surface, as vast stretches of stone and sand, and with a reduced specific biocenosis [3]. Based on a torrid climate or, on the contrary, extremely frigid, deserts fall into two broad categories: hot and cold.

Most hot deserts are found on both sides of the Tropics, the largest of which is the Sahara Desert. The Arabian Desert, southern Iran, the Thar Desert on the Pakistani-Indian border, the regions around the Gulf of California (USA), Arizona, are also famous hot deserts in the northern hemisphere. In the southern tropics, there are other important hot deserts: Atacama (South America), Namib and Kalahari (Africa), the Australian desert (Australia). Located in the Tropics area, all these deserts have a very warm climate, but also with great differences in temperature from day to night. The cold deserts of the northern hemisphere are located either at mid-latitudes - the deserts of Eurasia, between the Black Sea and Mongolia (Gobi, Karakum, Tungaria) or on highs surrounded by mountain peaks (Tibet, Asia). Of those located in the southern hemisphere, the most important ones are those from the Andes (Altiplano) and the Patagonia area. Warm in summer, they have a very cold winter, which lasts 5-7 months [4].

Strong winds (Siroco, Maghreb, Hartman, southern Africa, Samal, Mesopotamia) move the sands by collecting them in dunes, sometimes in the form of barges (sands gathered in the form of a horseshoe or crescent, with an average height of 15- 20 m) sometimes in trunks or the form of pyramids, thus forming the "fields" of the Sahara, called ergs. Larger than the sand, the bedrock covers 2/3 of the surface of the desert. Very violent desert rains form streams that dig deep traces, called wetlands in the Sahara, or that are quickly absorbed by the sand, feeding underground lakes. Platforms with cliffs, ravaged by violent winds, are called hamades. Desert vegetation is reduced to cacti and sap plants, and fauna, dromedaries, and camels, African antelopes (in America), beetles (in the Sahara), gerbils (in Arabia).

The people of the desert are nomads, living from hunting or the few fruits, and others grow animals (Tuaregs from the Sahara, Bedouins from Arabia or Mongols from Central Asia), traveling in search of pastures. In the middle of the desert, there are sometimes oases, ie places where springs come to the surface, favoring the development of specific vegetation, which represents the rescue of the inhabitants. Of concern is the phenomenon of extending deserts; The Sahel, an intermediate space between the Sahara and more humid areas, is constantly invaded by the desert, the Sahara thus advancing 250 km south.

2. MATERIAL AND METHODS

The present work aims to conduct a comparative study, to establish the main common elements, between the naturally formed deserts (at a global level) and the anthropic ones (at a local level), for the latter considering the areas of Maramureș county, affected by. the mining activity pollution. As for the naturally formed deserts, which we considered to be specific ecosystems, we reviewed the formation, distribution across the globe, as well as the characteristics for each particular type of desert (temperature, precipitation, soil, landscape, and biocenosis). On the other hand, the local desert areas, as a result of the mining activities, were briefly presented, the defining characteristics for the comparison with the naturally formed desert areas are strictly limited to the composition of the

surface layer, to the appearance (presence) of biocenosis and the landscape.

3. RESULTS AND DISCUSSION

3.1 Global Desert Areas Considered as Ecosystems

Depending on the local conditions (climate, geological substrate, altitudes and forms of relief, and so on), typical desserts are of several types: sand deserts (ergs, with their well-known dunes), stone deserts, and rocky deserts (with eroded mountains and erosion witnesses). In Fig. 1 (adapted after [2]) it is presented the distribution of desert areas around the globe, as well as the formation (causes) for each region, taking into account the maximum tropical atmospheric, the continental air circulation, the cold ocean currents, the distance away of the ocean, respectively the isolation inside the orographic dams.

How the bio-geographic environments are distributed according to the values that the temperature and precipitation variables can take, which gives dynamism in the biocenoses adaptation to the biotope conditions, is illustrated in Fig. 2 (adapted after [3]).

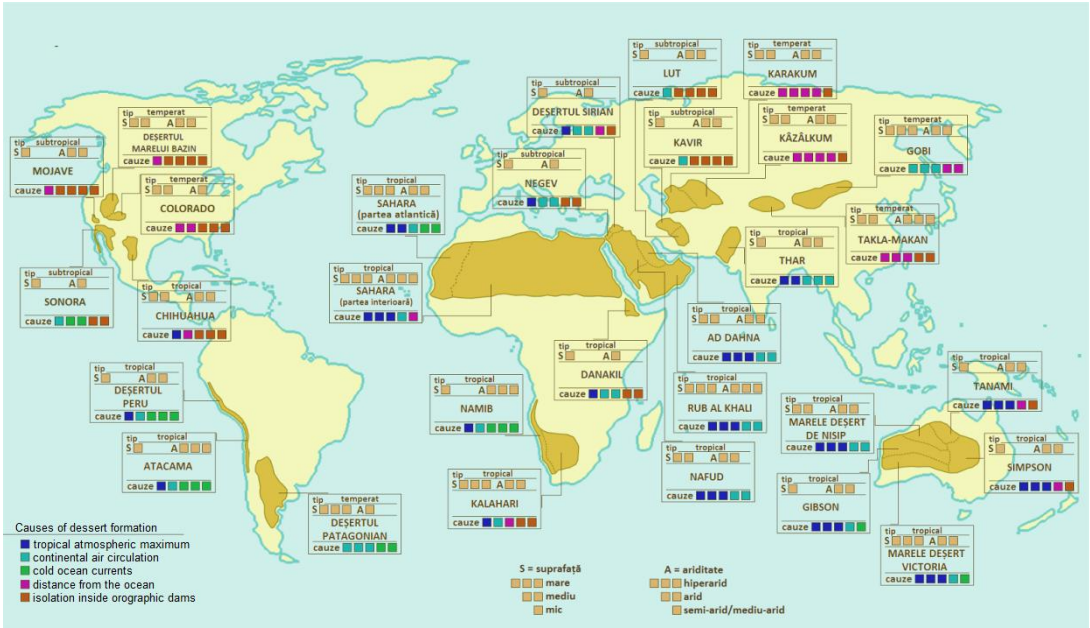

Fig. 1. Distribution and causes of desert formation around the globe

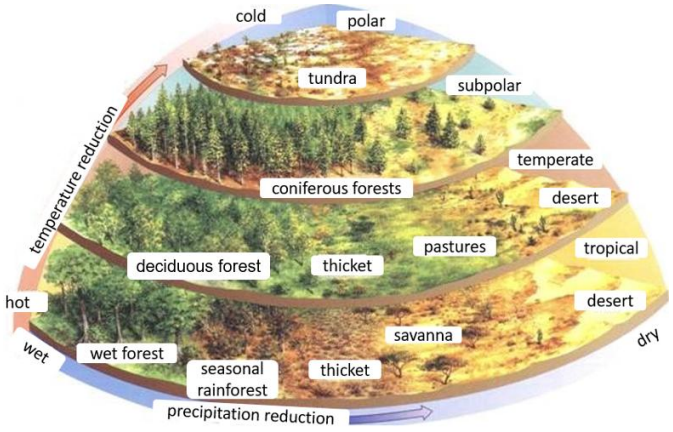

Fig. 2. Diagram of the biogeographic areas by reference to the specific conditions of temperature and precipitations

Deserts are a result of the hot and dry climate. The drought is permanent, the heat of the day is suffocating, and the rains are extremely rare. They are not completely devoid of life, but the plant and animal world is rare and has specific adaptations [4].

Plants have deep roots, waxy leaves or thorns, and the animals last long without water. The cover of desert ash is discontinuous and poorly productive. Most of the desert has no soil, but sandy or rocky stretches. As a result of temperature and precipitation variations, different types of deserts are noted, each of them having a series of well-defined characteristics, which we have summarized in Table 1 [4].

Within one or another of the above categories, deserts are most prominent with continental belonging, so we have: The African hot desert (Sahara, Libya, Kalahari and Namib), the hot desert North and South American

Table 1. Characterization of the main types of desert existing on the globe

No.	Types of deserts	Characteristics
1	 Warm and dry desert	Temperature: ~22-40°C Precipitations: ~150-300 mm/an In the upper layer the sand dunes predominate, which were born through the erosion due to the wind. In these arid regions (with extremely torrid and long summers) live plants and animals adapted to the lack of water: plants crassulaceae, xerophytes, and reptiles, insects, arthropods, dromedaries, etc.
2	 Semi-arid desert	Temperature: ~5-15°C Precipitations: ~200-450 mm/an The superficial layer is made up of rocks, the result of the disaggregation and the large temperature differences. Summers are moderately long and dry, winters usually bring rain. In these regions, more sporadic and discontinuous vegetation appear, compared to the dry deserts.
3	 Coastal desert	Temperature: ~15-22°C Precipitations: ~200-450 mm/an The superficial layer is made of salt, and appear through the processes of erosion and deposit of the material brought by glaciers or as a result of the evaporation of the water, in which the salt was dissolved. The soil is sandy, having good drainage.
4	 Cold desert	Temperature: ~0-5°C Precipitations: ~200-450 mm/an The superficial layer is in the form of ice deserts, which appear in areas where the low temperature has prevented the vegetation development. In some areas, rainfall may be heavy in specific season. The soil is hard, clayey and, at times, very salty.

(Greater Basin, Baja California, Mojave, Sonora, Yuma, Atacama and Patagonia), Asian hot desert (Gobi, Greater Nafud, Syrian and Sinai), European hot desert (not representative, but it is meets in Spain, northern Black M. and western Caspian), the Australian desert (Victoria and the Great Sand Desert), and the cold desert (Arctic - Greenland and Antarctic).

3.2 The Mining Areas of Maramures County Considered as Desert Areas

In the north of Romania, it has always been an area with very intense economic activity in mining and metallurgy, in various forms, and formed according to the political-social situation of the region. In such context, the study itself was conducted recently, regarding the period 2015-2017, when there were still field visits to various industrial sites, as well as in some areas of interest (in terms of pollution, taking remedial action, or simply in the form of internship activities with students).

The evaluation of the relatively limited environmental conditions considered, strictly at some areas adjacent to the tailings ponds in Maramures county (see the map presented in Fig. 3), was the result of field visits, which tried to know how ecosystems respond to mining activity. Also, the present material (especially the dozens of pictures taken in the field) was often a specific study of disciplines such as ecological management and applied ecology.

Maramures County has been and may continue to be an economic engine in which mining and metallurgy can be at the forefront [5]. If we were to review what mining meant for Maramures, we would need an extended typographic space, so we will try to point out, in a brief way, what mining in the north of the country meant.

Mining has been the main occupation of the inhabitants of the entire region (Fig. 3) since ancient times and one of their main sources of existence [5]. The most important resources were identified and exploited in Ilba, Nistru, Băiţa. Herja, Baia Sprie, Cavnic, Băiuţ, Ţibleş, and Vişeu, which made Maramureş, in various periods of history, hold the first position in the country's economy, both in terms of extraction volume and gold production and silver.

The oldest mining basins are those in Baia Mare, Baia Borşa, and Lăpuş. The exploitation of the non-ferrous minerals was the main economic activity of the Maramures residents until the abusive closure of the non-ferrous mining, in 2007.

Among the main elements that are particularly important and that do at the same time, together with the observations on the landscape (Fig. 4), the object of the comparative study is the hydro-climatic and pedological conditions [6]. It is therefore appropriate to review the hydroclimatic and pedological characteristics of the location of local anthropic deserts.

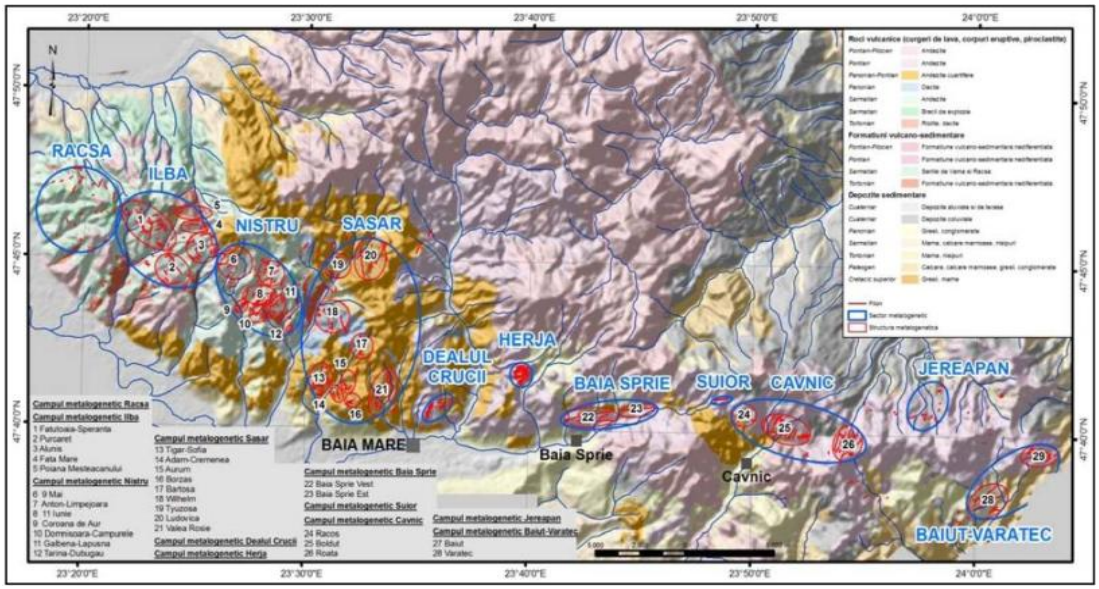

Fig. 3. A distribution map of mining areas in Maramureș county

At the shelter of the mountains and under the influence of the humid-ocean air masses from the west, the Maramures County has a temperate continental climate, in which the winters are relatively mild and the summers relatively cool [5-7]. Although this type of climate (temperate continental) is characterized by torrential rains, frequent in summer, alternating with periods of drought and high annual thermal amplitudes, in the area of the Baia Mare Urban System these features are not so well expressed, which is why it can add the "moderate attribute" of the continental temperate climate.

The multiannual average temperature in the municipality perimeter is 9.4°C, with variations from one year to another in the thermal difference 7.9°C (1933) and 11.4°C (1872). In winter, the average monthly temperature in depression reaches -5°C, and in summer it rises to 18-20°C. The absolute thermal extremes determine the appearance of an absolute thermal amplitude of 69.2°C. Thus, the absolute minimum temperature was registered on 10.02.1928 (-30ºC), while the maximum absolute temperature reached 39.2ºC, on 22.08.1943 [5].

Significant for the cold season is the production of temperature inversions, during which the air temperature is lower in depression compared to the higher spaces around it. These investments, however, have a lower frequency in the Baia Mare Depression. Frost phenomena occur as a result of lowering the air or soil temperature below 0ºC, the most dangerous frosts being those of the transitional seasons, spring and autumn. The gel cycles (the freeze-thaw alternation) are quite frequent, favoring the degradation of the superficial layer of soil by weakening the cohesiveness between the granules that compose it.

In Baia Mare Depression frost days have a frequency that is around 100 days, while frost-free days are between 160-170 days. On the ground level, the first frost occurs, on average, on October 12, and the last on April 24. In Table 2 [5] are exposed to some of the weather-climatic characteristics specific to the mining areas in Maramureș County.

As can be seen from the collage of images shown in Fig. 4, as well as a result of the observations made in the field, on the spot, it is found that the environmental conditions are unfavorable to the normal development of the flora species, the landscape being atypical, sometimes even frightening.

Also, the disproportion of the landscape conferred by the format and dimensions not to be neglected of the tailings ponds and tailings dumps, which remained after the mining activities in the area, only disgust and upset us that we are somehow part of the helpless community to the cruelty applied by the industry on the environment and biodiversity. Left as it were, the respective areas make us think of the oases of the desert, but the Morgana girl who should calm us down, give us hope for better, peace, rest and abundant resources, is nothing but a mirage, blurred by mining remnants.

Returning to the hydrometeorological conditions, it can be mentioned that atmospheric precipitation records average multiannual values of 650-950 mm in depression, in the corridor of Someş, the lowest values are recorded, and in the area of the Baia Mare (935.5 mm). The high value of the amount of precipitation in the area of Baia Mare is determined by the orographic convection of the wet air masses in contact with the neighboring mountain chain and by the

Table 2. Weather characteristics specific to the locations of local mining areas

Month	Air temperature (°C)			Number of days under 0°C	Wind speed (m/s)	
	max.	min.	average		average	maximum
January	9.5	-16.6	-2.4	25.5	0.7	10
February	11.4	-17.3	-0.9	23.2	1.7	9
March	26.6	-4.7	4.2	16.4	1.6	10
April	27.5	-2.0	10.1	4.8	1.4	9
May	29.2	2.0	15.2	0.4	1.4	9
June	32.1	3.7	18.2	0	1.4	8
July	31.7	8.2	19.9	0	1.3	9
August	33.6	9.0	19.1	0	1.1	8
September	31.6	3.0	15.1	0.1	1.4	10
October	24.0	-5.8	10.0	2.4	6.9	8.8
November	18.2	-2.9	4.3	10.1	1.1	8
December	12.5	-9.2	0	20.8	1.2	8

Fig. 4. Aspects from areas affected by mining pollution, Maramureș county

pollutants released from the pollution sources of the Baia Mare Municipality, which plays the role of condensation nuclei for vapors of water.

The days with precipitation are around 160 days, the monthly minimum being recorded in September (8-10 days). During the cold period, atmospheric precipitation falls into a solid form. The average number of days with snow-covered soil is 67.2 days. Regarding the hydrological and pedological conditions on the site, these are exclusively guided by the way the material behaves as industrial waste, which has been deposited over time as a result of mining activity in the area.

It is worth mentioning that the entire mining activity produces, due to its specific nature, multiple and varied negative effects on the environment [8,9]. Can thus be exemplified changes in the relief (manifested by the degradation of the landscape and relocations of the households and industrial objectives in the exploitation areas), the occupation of large areas of land (for the activity of exploitation, waste disposal, storage of useful mineral substances, industrial installations, access roads, etc., surfaces that thus become unusable for other purposes, for a long time), degradation of the land (by vertical and horizontal displacements of the surface and the sliding of the sludge and the

tailings ponds, causing serious accidents and the impurification of the environment as a whole, combined with the creation of an imbalance that can affect for many years the integrity and the health biota.

4. CONCLUSION

Through this paper, we set out to show that the truly desolate landscape, which appeared as a result of the development of local mining activities, which we are active witnesses and with which we come into contact during field trips, is comparable to the desert of worldwide. Hydrometeorological conditions, as well as the lack of actions and programs to rehabilitate the affected areas only aggravate the habitat, most often of coniferous forests, at the limit of which industrial waste landfills have appeared in one form or another.

In conclusion, natural deserts are formed as a result of the dry climate, appearing in both the hot and the temperate and cold areas. Also, the natural desert may be the result of the regional characteristics of the atmosphere, the ocean-continent relationship, the relief or the ocean currents; however, compared to the anthropic desert - from the former mining areas (comparable in terms of landscape and biocenosis), the natural desert is capable of self-control and stability, it possesses a specific biocenosis, as result of its dynamics, an aspect that is completely missing from the characterization of the anthropic desert.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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