LOCAL COMMUNITY SUPPORT TO POLLUTED SITES MANAGEMENT

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Abstract:Tailings are land on which the waste material is stored, from ore processing to metal extraction. Even though currently mines and processing plants are currently inoperable, these deposits are still a current issue of natural environment management. A concrete case concerns the tailings ponds in the Baia Mare depression, located in the proximity of the localities, for which they constitute a permanent threat. Although there are many studies and concrete actions on ecological remediation and their natural space rendering, the problems they generate are far from being resolved. The article presents the results of an ecological remediation study using plant and mushroom species from the native flora and proposes integrating them into a wider management scheme. To optimize the remediation process for an efficient environmental management and for the preservation of the population's health, we propose an integrated management scheme that takes into account the corroboration of biological and socio-human factors. Involvement of local communities reduces the time needed to integrate these polluted areas into the natural circuit.

Keywords: local community, health, socio-humand factors

Introduction

Industrial lands have abiotic and biotic conditions completely altered due to anthropogenic intervention. One of the most dramatically modified categories is tailings ponds and tailings dumps where the soil substrate is replaced by mining or ore processing material. The presence of the tailing deposits conduct not only the water pollution but also the air pollution, having as immediate effect the transformation, the degradation or the total destruction of the structures of the biocenoses from the adjacent zones, affecting both the terrestrial and aquatic flora and fauna.(Jelea et al.2007).

The water regime changes significantly due to changes in substrate permeability and very acidic pH. Under these conditions, the vegetal carpet is completely changed, degraded and depleted. Substrate replacing soil is loaded with heavy metals. Thus, natural ecosystems disappear, and their functions are also annihilated, which has a negative impact on the quality of life of the nearby human communities. Numerous efforts have been made recently to find ways to remove heavy metals from the soil. For chemically polluted lands, vegetation plays an increasingly ecological and sanitary role. (Antonkiewicz et al, 2002, Igwe et al., 2003, Horsfall et al., 2005).

Proper plant management in such areas can make a significant contribution to restoring the natural environment. Studies by various researchers (Kumar et al 2007) have shown that vegetation can remove Mn, while other metals such as Zn, Cu, Pb, Ni are removed by rhizophiltration mechanisms. Ike et al. 2007 showed that symbiont bacteria can be useful in the phytoremediation of heavy metals polluted lands. Muneer et al. (2007) have shown that isolated yeasts can be exploited for bioremediation of chromium-containing waste, demonstrating that they have the potential to accumulate this toxic metal in the soil. Phytoremediation is a much cheaper process, with the use of native plants in polluted areas. (Chehregani et al., 2007). One of the best ways to minimize environmental hazards and associated regulatory problems caused by the introduction of non-native biota (including genetically modified species) is the use of native species for remediation. (Frick et al., 2008).

The use of native plant species can serve a double purpose, remediation and rehabilitation / recovery of the native habitat required for the success of the remedy. (Alberta Environment, 2001), (Saskatchewan Petroleum Industry, Government of the United Kingdom and Saskatchewan, Guideline 1999). In addition, the perception of environmental benefits appears to be one of the best strategies of phytoremediation, that of microbial assisted remediation, because native species are already adapted to the site's conditions. Minimizing the environmental risk of non-native (non-transgenic and non-transgenic) phytoremediating species consists in the employment of isolated biological organisms in the system (Gressel et al 2005) (Ronchel et al., 2001). (Gerhardt et al., 2009) (Liu et al., 2005).

Matherials and Methods

For the efficient management of the tailings ponds, the present situation of both the abiotic factors and the installed biodiversity, partially spontaneous, partly with anthropogenic intervention was evaluated.

A number of 14 sample areas (Table 1) with a surface area of approximately 100 m2 each were identified and selected at the level of which: microclimate determinations, sampling of soil, microorganisms (bacteria, fungi) phytosociological relevases. The terrestrial invertebrate fauna has been inventoried and monitored. A complete and correlated analysis of all ecosystem components has been carried out to capture the ecological relationship between organisms and the environment

Table. 1. The geographic coordinates of the sample

		Sample	Longitude	Latitude	Altitude
			centizecimal 023o	centizecimal 47o	(m)
1	A	1	28.75	38.63	178.6
		2	28.74	38.63	181.4
		3	28.73	38.62	184.4
		4	28.73	38.62	184.4
2	B	5	28.74	38.61	182.9
		6	28.75	38.61	182
		7	28.76	38.59	181.5
		8	28.76	38.58	181.4
		9	28.75	38.58	182.9
		10	28.74	38.57	184.3
3	C	11	28.75	38.57	182.6
		12	28.75	38.57	181.1
		13	28.76	38.56	177.1
		14	28.76	38.55	167.9

Floral and mycological species were analyzed from field studies and specimen harvesting. In the laboratories of the Tenhnic University in Cluj Napoca, macroscopic and microscopic analysis was carried out and specimens from the taxonomic herbs were identified in order to identify them.

From the local community, a representative sample was selected for age, gender, training grade, composed of 50 individuals who were interviewed with a structured interview of 10 questions about the presence and impact of the TMF in the vicinity of the locality.

Results

The Bozânta Mare pond was formed by collecting the waste water tailings resulting from the non-ferrous metals and cyanide processing activities from the mining of gold minerals. The amount of deposited mining tailings had fluctuating dynamics over the years, in direct relation to the nature of the extractive activities. In recent years, there has been a significant decline due to the decline in mining activity in the region.

The Bozânta Pond has an area of approximately 1,000,000 m² and is organized on floors - slopes - formed by depositing tailings loaded with unprocessed residues of non-ferrous ore and wastewater rich in heavy metals (Pb, Cd, Cu, Mn, Zn etc) and cyanide. Unprocessed non-ferrous ore (pyrite and calcopirite), which is the most important component of the pond, underwent an oxidation process over time due to the contact with air and rainwater. The physico-chemical transformations of the tailings are also determined by the activity of the microbiota of the soil, which has a certain specificity for acidic conditions (pH 2-3.5) and heavy metal load.

Regarding the phytoremediation of the polluted site at Bozânta Mare, the actions were started about 25 years ago by trying to plant species with high resistance to acidic soils and loaded with heavy metals. In the creation of a vegetal carpet that reduces erosion and especially the dispersion of the surface dust of the heap, early non-native species were used, which were rapidly growing: *Pinus nigra, Robinia pseudacacia, Prunus serotina, Amorpha fruticosa* and specimens of species belonging to the regional flora such as *Quercus petrea, Salix caprea, Populus tremula, Betula pendula* spontaneously installed. The vegetal carpet, rather poorly represented, includes herbaceous species specific to the region, *Hieracium pilosella, Carex pillosa, Centaurea austriaca, Viola arvensis, Rumex acetosella, Linaria vulgaris, Agrostis capilallaris* etc, and adventive weeds such as: *Reinouttria japonica, Erigeron canadensis, Setaria glauca* .

Revegetation was carried out on all floors of the heap, but the number of current taxa has a higher survival rate and spread on the N-E slope. The first slope on this slope is occupied in quite a large proportion by the species *Rubus fruticosus.*

Populus tremula, tremulous poplar is a native species that has grown relatively well especially on the slope 1 and 2, predominantly propagating vegetatively. It is one of the most longevous species on the tailings heap due to the development of a superficial, highly branched radicular system that drags massively.

Poplar, willow, birch are species that have been identified as symbiotic associations of the ectomicorrhiza species, with a determinant role in the survival and development of these species under chemical stress conditions.

The acacia, *Robinia pseudacacia*, spontaneous mellifera tree, is present in all the heap floors, through a relatively high number of individuals but small in size. It is a highly adaptable species for poor nutrient substrates with increased resistance to moisture.

Salix caprea, has a good distribution especially on the N-E slope, the species coming from natural dissemination. The radicular system is superficial and displays abundant ectomicorize on the second order, which explains the normal development of the species, even if their number is small. Wagtail is a species that has a rapid growth and high longevity (over 50 years) with good tolerance to arid and polluted lands.

In addition to the species of cormorant flora, the mushroom species growing on the tailings pond slopes were evaluated. 13 species of macromycetes, identified in Table 2, have been identified:

Table 2 Specific diversity of macromycetes on the Bozânta Mare pond

Nr.	Species	Distribution

Crt.		
1.	*Laccaria laccata*	terraces I, II, on the slopes and on the plateau; on the north-western side of the pond
2.	*Scleroderma citrinum*	terraces I, II, versatile and on the plateau; on the north side of the pond
3.	*Inocybe lacera*	terrace I, N-V exhibition
4.	*Xylaria hypoxylon*	terrace II, exhibition N-V
5.	*Suillus bovinus*	terraces I and II, N-V exhibition
6.	*Calvatia excipuliformis*	terrace II.
7.	*Telephora terrestris*	terraces I and II on the slopes and on the plateau; the sporadic bodies in the vicinity of the trees are very abundant, both of the specimens of *Pinus nigra* and those of *Salix caprea*, *Populus tremula* and *Quercus robur*
8.	*Amanita muscaria,*	plateau in large numbers of specimens associated with *Salix caprea, Betula pendula* and *Populus tremula*
9.	*Pisolithus tinctorius*	terraces I and II, on the slopes and on the plateau, on the N-V exhibition
10.	*Paxillus involutus,*	terraces I and II on the plateau.
11.	*Russula aeruginea,*	on the plateau, N
12.	*Russula cyanoxantha*	plateau associated with *Populus tremula*
13.	*Marasmius oreades*	terraces I and II on the N-V exhibition
14.	*Suillus grevillei*	on the second terrace

Besides the species of macromycetes, in the fungal flora of the substrate on the lake were identified 15 genus and species of fungi such as: *Saccharomyces sp.; Saprolegia anisospora;* Zygomycotina; *Mucor hiemalis; Umbelopsis nana;* Ascomycotina*; Chaetonium sp.; Glomerella sp.; Massarina sp. Nectria sp.;* Basydiomycotina*; Coprinus sp.; Armillaria sp.;* Deuteromycotina *Aspergillus fumigatus; Aspergillus niger; Humicola dimorphospora; Penicillium corylophilum; Rhizoctonia sp.; Trichoderma sp.* The fungal species develop adaptive mechanisms in soils loaded with heavy metals in close correlation with the species present in the surrounding vegetation. Despite their ability to survive in severe environmental conditions, such species as *Telephora terrestris, Pisolithus tinctorius, Amanita muscaria, Russula emetica* are able to accumulate heavy metals in high quantities. These fungi support the development of vegetation, functioning as a sort of "bio-filters" for the roots of plants, thus enabling their survival chances. Through a good application of mycorrhizal-activating symbiosis, or by the inoculation of mycorrhizal micelles in the roots of plants, the initiative of bioremediation of soils polluted with heavy metals has high chances of gaining efficiency.

The results of the structured interview conducted with members of the local community in the neighboring area highlighted the following:

Locals are worried about the presence of the tailings pond, which they perceive to a great extent as current pressure on their health.

They do not have a clear perception of the nature of the impacts that the tailings pond material impacts on human health.

Cultivates and consumes vegetables and fruit products in the gardens and does not make a direct connection with the impacts of the tailings pond on soil and air.

They harvest and consume mushrooms from the tailings pond considering that they are edible can not have a negative effect on their health.

It does not identify solutions to remedy and counteract the presence of the polluted site in the vicinity of the locality.

Conclusions

Anthropic polluted sites, such as tailing ponds, are major threats and pressures on human communities for long periods of decades or even centuries. The situation is due to the fact that the heavy metal load as well as the restrictive characteristics of the abiotic factors prevent the consolidation of ecosystems that perform ecological service for the community.

Natural succession takes place with the establishment of symbiotic relationships between plants, mushrooms, fauna, but the duration of the natural installation and consolidation of the ecosystems is very high.

The human factor responsible for the management of polluted sites must include in the management plan multiple awareness actions with human communities, in order to diminish the impact of these areas on health.

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