CONCEPT OF RECLAMATION MANAGEMENT OF THE ASH POND TŘINEC (THE CZECH REPUBLIC)

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ABSTRACT

The presented contribution deals with the former ash pond study in the Třinec city, which is one of the most important industrial cities in the Czech Republic. The study was focused on the research of spontaneous succession ongoing in the study area almost 50 years and also focused on the evaluation of success in realized reclamation. There was designed a reclamation management based on the obtained information about the study area. The management was prepared according to the methodological procedures of directed succession. Individual management measures for the future care of the area were designed sensitively according to the locality integration in the surrounding landscape without disturbance of current spontaneous succession. Scientific benefit of the contribution is to draw attention to the possibility using methods of conducted succession for designing reclamation of former industrial sites, ash ponds or other non-functional and unused Brownfield sites.

Keywords: brownfields, reclamation, restoration ecology, spontaneous succession, ash pond, Třinec,

INTRODUCTION

Today, many authors have devoted their work to restoration of damaged sites by industry and their reintegration into the landscape.e.g. [1], [2], [5], [8], [9].

In recent years, restoration ecology becomes a relatively new concept - from the English expression “restoration ecology". The description of this sub-discipline of ecology, which was developing from the 80ths of the 20 century, was handled e.g. [6]. The method of restoration ecology is controlled succession, which was described by many authors, such as [3]. Controlled succession process in the restoration is based on the use of higher natural successional stages corresponding to the sequence of successive ecotopes. Controlled succession process includes spontaneously arising vegetation

support, its tuning and reinforcement, especially by native plants substitution. Than the communities arise, that exhibit different, but for the purpose for which it was founded more favorable characteristics, than communities that would be developed completely by spontaneous succession. It is used for environmental restoration of sites affected by mining activities, or other industrial activities. There are many of these damaged sites in the Czech Republic. Large amount of literature can be found in the field of the landscape restoration in after mining and quarry mining in the Ostrava-Karvina district or reclamation of spoil heaps and heaps in Ostrava. This topic is dedicated to authors such as [4], [7].

MATERIAL AND METHODS

Storage of energy waste (slag, cinder, fly ash) Energetika Třinec, a.s. is located in the Třinec – Dolní Líštná cadastral area in Moravian-Silesian Region in the northeastern part of the Czech Republic. Storage was established in the valley of Dolní Líštná in 1962 by the construction of the first dam at an altitude of 356 m. Storage activity was terminated in 1998. During the storage of waste the dike system was increased, which currently consists of 13 terraces, with the last edge of the terrace at an altitude of 403 m. The terraces are 5-7 meters wide and 3 meters high, see Figure 1. The total area of the dam with plain ponds is 26.87 hectares, interest area of the reclamation management refers only to terraces system with an area of 11.8 hectares, as it was necessary to leave the plateau without reclamation because of possible further use of power plant waste storage in the future. Barrier system of the storage is relatively densely covered with vegetation. The largest representation of mixed stands of trees and shrubs is in the oldest terraces, the middle part consists of the same-aged white birch culture (*Betula pendula*) and willow willow (*Salix caprea*). There is sporadic vegetation comprising self-seeded tree species, shrubs and grasses in the youngest terraces dam system. The vegetation is gradually spreading in response to a newly built dam even during the storage activities.

Ash pond Třinec

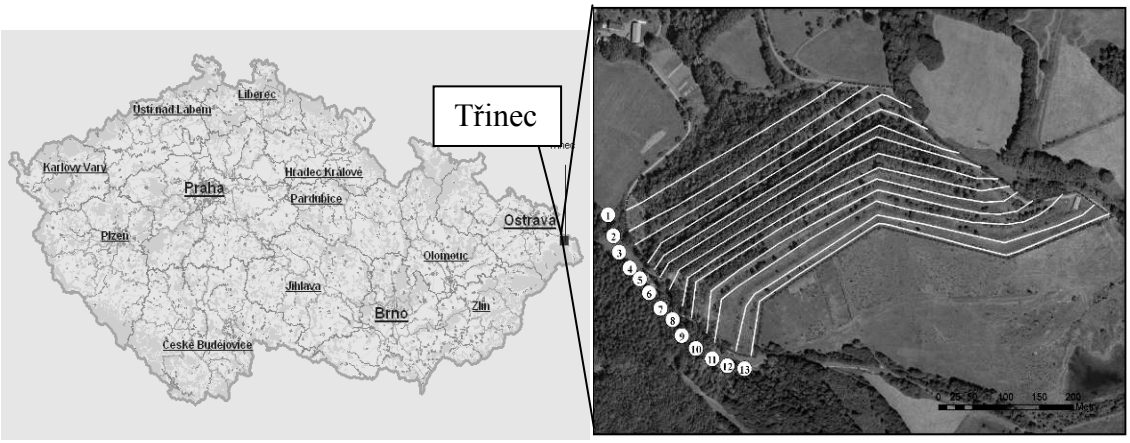

Fig. 1 Study area localization and individual terraces of repository

During the raising of the dam occurred on the lower terraces the spontaneous succession especially pioneer trees such as silver birch (*Betula pendula*), aspen poplar (*Populus*

tremula), willow willow (*Salix caprea*), the mosses, grasses, higher plants took root. Some terraces were planted with amelioration trees, especially birch (*Betula pendula*), sycamore (*Acer pseudoplatanus*), willow willow (*Salix caprea*) and aspen (*Populus tremula*), then spruce spruce (*Picea abies*). Thanks to the nearby suburban forest, composed mainly of coniferous species such as spruce (*Picea abies*), larch (*Larix decidua*), but also deciduous species such as beech forest (*Fagus sylvatica*), sycamore, milk (*Acer pseudoplatanus, A. campestre, A. platanouides*), winter oak (*Quercus petraea*) heart-shaped linden (*Tilia cordata*), these trees could successfully spread on the terraces.

On the barrier system, there are probably due to changes in habitat conditions drying out timbers that are naturally linked to wetter habitats. The fungal disease (*Rhytisma* family) on maples often appears. In some tree species there are snakes on the trunk, probably caused by spring frosts. In terms of successive stages, the braking element of natural regeneration is considerably dominant shrub layer on older terraces, composed essentially of the following species: dogwood (*Cornus sanguinea*), dog rose (*Rosa canina*), hawthorn (*Crataegus monogyna*), general chokecherry (*Prunus padus*), viburnum general (*Viburnum opulus*), hazel (*Corylus avellana*), blackberry (*Rubus sp.*). Significant risk for the entire area represents spread of alien species, particularly Japanese knotweed, Canadian goldenrod, black locust from the timbers. Potential threats are overthinned silver birch stands, willow willow and poplar aspen, that make up a third of the territory and are associated with the risk of fractures and fallen trees due to storms. For these nearly monocultural forests also represents a serious risk of fungal pathogen occurance (*Piptoporus betulinus*). In terms of the content of humic substances can be individual terraces evaluated as humic, but the three youngest terraces, with very sporadic vegetation as a slightly humic. The content of humus is due to the age of individual terraces downward trend. Its quantity is directly proportional to the time when there was organic matter to accumulate and thus the state of vegetation. From the crowns of previous dams, the vegetation was removed, and therefore could vegetation develop particular in parts of the slope terraces. These interventions are most evident in the middle terraces where slopes parts are formed by stands ofoverthinned birch woods, birch country lines and willow willows, while on the crown, there is only herbaceous vegetation. With the gradual increase of the dam modifications crowns were shifted to younger terraces. On the lower terraces, this effect is also evident. The slopes of the terraces are covered with full-grown trees and edges are after removing vegetation overgrowned by weeds. These parts of the terraces are absolutely impenetrable.

Metodology

Reclamation management issues were addressed by the managed succession using underplanting, removing unwanted trees, shrubs and herbs. This procedure was modified and supplemented as follows:

1) site preparation (weeding, disposal of some species),
2) care of the existing vegetation (underplanting, establishment of vegetation),
3) planting trees (selection of species composition, selection of planting material, the technique of planting);
4) care of introduced species (multi-plan care),
5) land use proposal in terms of socio-ecological view.

Reclamation Management has been designed with regard to: maintain the natural development of the site, promoting natural regeneration and advance growth of air raids, a gradual transition preparatory to the target species of trees, a nature-like sites with nearly identical ecological characteristics for the development of vegetation and animal life, which are secured in the near surroundings and to meet the social needs of the individual entities that are directly or indirectly linked to this site. Reclamation management proposal and actions aimed at creating a stable ecosystem, multifunctional and environmentally sustainable landscape vegetation in the reclaimed area, which will perform a multi-function term remediation, reclamation, biological and recreational or educational production in the future will require the least inputs and energy supplements. To improve awareness of local citizens, it was proposed to expand the route or trail that is located in a nearby building and information boards about the history repository, the current vegetation management planning and communities recovery. The resulting terraces – formed field has considerable aesthetic value, which will be underpinned by appropriate planting of trees or groups of individuals with diverse species composition. Part of the site will be left to natural development of vegetation for the possibility of examining and comparing the current course of succession in this area with other similar store in the Czech Republic or in other countries and the possibility of applying the proposed management area similar to human nature. This area is not in any way will be interfered with silvicultural, only in exceptional cases (calamity, harmful pests and invasive plants). For these purposes has been designed a segment called *silent area*. In the context of closer multifunctional ecosystem is to be expected timeline for decades, the primary function of the individual will fall into different periods having its main task and a different management, but they overlap and complement is absolutely crucial. The interweaving of functions and their importance varies in a given period are shown schematically in Figure 2

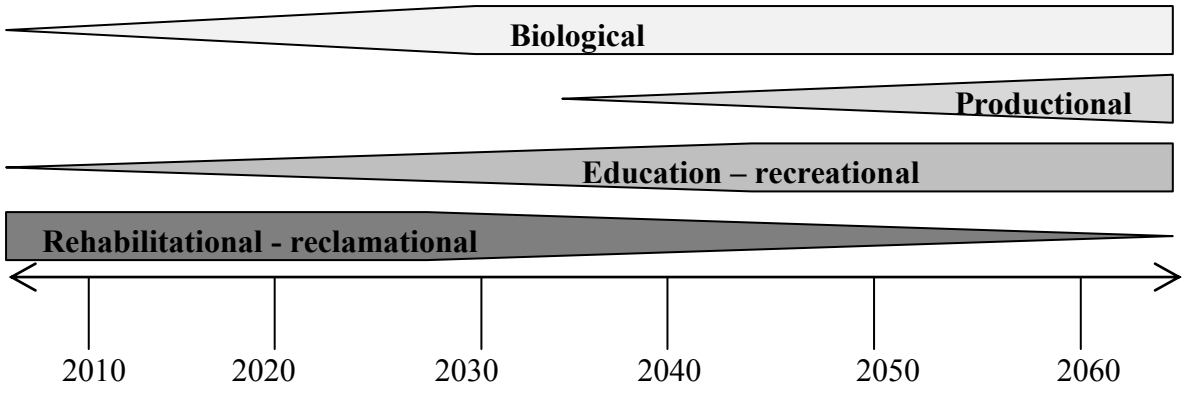

Fig. 2. Illustration of the changes in the importance of each function in the time frame out-forrest green terraces at the store.

RECLAMATION MANAGEMENT

Selecting the planting material, site preparation

For planting is proposed to use transplants coverroots seedlings preferably from nurseries with similar ecological conditions. Preparatory stands of the silver birch will be based by sieving the seeds. Site preparation will be raking off sward using hand hoes

or spades. Silent boundary areas are planted with shrubs to prevent the access. For sprouts and improvements will be used strong half-grows up. The list of species is given in the Table 1. Shrub layer is constructed of species: *Rhamnus catharticus*, *Euonymus europaeus*, *Cornus mas*, *Padus avium* and *Cornus sanguinea*.

Formation of new plantations, planting individuals

Mixed stands of deciduous trees will be established and planted will be individuals primarily in underplanting. Planting stock of root ball is the best planted in the fall or early spring. Planting hole will be dug by hands with hoes and spades with the size of min. 3 times larger than the root system, or root ball. As needed, there will be added to the planting pit the manure (eg NPK, Cererit) or a layer of topsoil. Surface planting will be implemented with minimal numbers per hectare refer to Table 1 and in groups in a square buckle, min. seedling length 1 m, or individually. After planting, apply a dressing and checked regularly.

Liquidation of invasive plant species and regular site mowing

Dispose of weeds and invasive species, particularly the Canadian goldenrod carried out mechanically or by wheeled trimmer mower, term in late May and late August Reynoutria should be liquidate in August and September with the herbicide, withered biomass discarded. Treeless meadows and left lea sites mow mower regularly 2 times a year.

Care of air raids, periphyton and based vegetation mats

Protection against animals (feel, exfoliation) - protective netting, tubes around the trunk, to protect the culture with repellent coatings (e.g. Morsuvin, Aversol). Mechanical protection of wire or plastic with a minimum lifecycle of 2 years. It is also necessary to be aware of not damaging trees or also to prevent them from poor measures resulting in suspension of growth. Planted areas should be protected with the fencing. Removal of weed-best should be done by hand sickle, 2-times in the first 2 years followed by once another 3 years after establishment, removed biomass should be left in the place.

Vegetation upbringing

During the trees thinning up to support the natural composition and natural structure (in groups and clusters) of the growth. When there is the thinning treatment species composition should be also adjusted (the release the target species by liquidation birch - willow stands). The pursuit of natural vertical and horizontal differentiation stands. Damaged implement health choices of individuals. Removal of trees carried out by the choice way (individually and in groups). Thinning, release and removal of undesirable trees perform mechanically using power saws, thin stems or shrubs remove with brush cutter. Hazel acacias and stumps treated with herbicide (Roundop). When the release of the stands, using directional felling and provide gentle clearing of timber with tractors.

Measures to meet the educational and recreational functions

Building on the existing route or nature trail, access path field, build a bench with 3 interceptions and a nature trail signs giving information about the area, its history, management, or the near future. Close to terrace 7 solidify existing parking with grass panels. The edges 7 and 12 f the terraces not to afforest, leave for potential rollers, after the industrial activity on the plain storage. Further, it is necessary to exclude inappropriate technologies to interfere with the soil surface and subsequently causing erosion. At the appropriate places to leave old trees in the physical decay and decompose min. 5 m^3/ha (volume of large) deciduous trees due to direct binding of some animals, especially insects, the dying trunks and thick branches.

The use of introduced species to the establishment cannot be permitted. All interventions carried out at designated places, particularly important omission is any interference (unless otherwise specified) and possible damage to the segment of non-intervention area, which is designed as a research area of natural succession. In any segment not to allow clear-way renewal. Maintaining the existing intersection for later use as a processing line. For this purpose, leave without woody vegetation edge of the terrace No. 12.

Table 1. Minimal numbers of planting stock for whole locality (generally)

Timber	Aim state (%)	Planting stock (st/ha)	Amount of use covered-roots material (st/ha)	Result number of planting material (st/ha)
Fagus sylvatica	20	9 000	7 200	1 440
Quercus petraea	15	10 000	8 000	1 200
Acer pseudoplatanus, A. platanoides	20	6 000	4 800	960
Tilia cordata	30	6 000	4 800	1 440

DISCUSSION

Industrial landscape renewal can be done through traditional technical and biological reclamation through forestry plantations such as [5], but also more and more controversy develops degraded areas to maintain natural succession and their own development. As a compromise in recent years, the method of the restoration of degraded land through controlled succession is considered [3]. This is precisely the less expensive way, for many owners of degraded areas and brownfields, it is the opportunity to transform these sites to ecologically stable ecosystems, and socially exploited new areas. This method was used in the design of fly ash storage reclamation management in Třinec, where the goal was to transform the vegetation dam resulting from spontaneous succession on species-rich structured forest ecosystem that is both functionally and continuously building on nearby suburban forest.

CONCLUSION

Whole area can be evaluate such a reclaimed area of anthropogenic origin, left to their own development. Open Aires are covered by spontaneous vegetation. Species timber composition is in most cases equal to preparatory growths, which are very overthinned or vice versa. Despite considerable anthropogenic influence, locality has a relatively large self-renewal capacity, but the lack of a systematic care plan of for this area has resulted in very intense damage to individuals from natural regeneration particularly hoofed animals, uncontrollable spread of invasive species and also absolute dominance of shrub layer in some parts of the site. In this paper proposal for reclamation management is presented, which was created for the owner of the site.

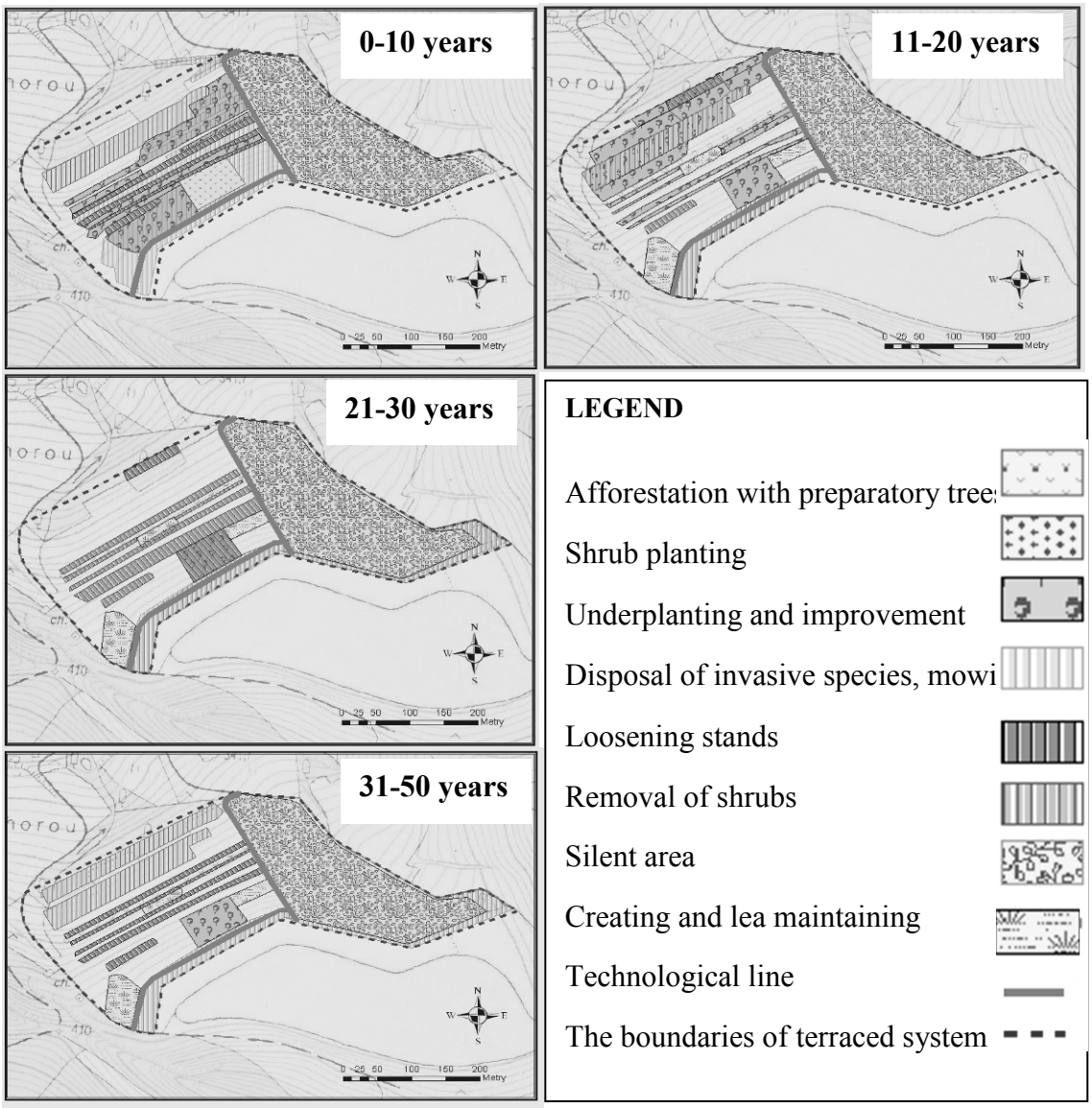

Fig. 3 The proposal of reclamation management for next 50 years.

Acknowledgment
The subscription originated in relation to solution of European project 1CE014P4: Manager Coordinating Brownfield Redevelopment Activities – Central Europe Programme co-financed by the ERDF.

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