MONITORING OF EVOLUTION PROCESS OF *P. CEMBRA* SPECIES RE-INTRODUCTION AND *P. CEMBRA / P. MUGO / P. ABIES* HABITAT RESTORATION TO THE END OF THE PROJECT
(Action D.2) Annexa 4

Introduction

To restore the degraded habitat from Pietrosul, a number of 15550 instead 10000 seedlings were planted, such as: 5000 dwarf pine (*Pinus mugo*), 4350 cembra pine (*Pinus cembra*), 2500 spruce (*Picea abies*) and 3200 rowan (*Sorbus aucuparia*). It is expected that once the planted cembra pine reach about 20 years after planting, cembra pine population starts to produce seeds and to regenerate itself and the cembra pine / dwarf pine / spruce habitat restores. From the project point of view, it is important to learn how this plantation develops. For this reason, the evolution process of the plantation was foreseen in *The after LIFE Conservation Plan*, so that, the results of successive inventories will let us learn approximately, how many trees per species will survive, let say, at age 20 or any other.

Objectives

This action has the following objectives, such as:

(1) to assess the evolutionary process of *P. cembra* species re-introduction and of *P. cembra / P. mugo / P. abies* habitat restoration on 50 ha;

(2) to create a data base with this evolutionary process of the plantation;

(3) based on the accumulated of evolution data, a working restoration model to be used in other Carpathian zones or in other countries with similar conditions.

Methods

To get a satisfactory precision, in the year 2005, 10 (instead of three foreseen) permanent sample-plots were established across the project area. Each plot with a circle form of 13 m radius was marked at its centre with a red stick to be seen from distance. In the autumns of the 2005 and 2006 and 2007 years, within each sample-plot an inventory of the seedlings was made according to a five steps scale that took into account the seedling health, as follows:

- A – 100% of seedling is green and has viable terminal shoot and bud;
- B –61 – 80 % of the seedling crown is green, and has viable terminal shoot and bud;
- C –41 – 60 % of the seedling crown is green, and has viable terminal bud;
- D – < 40 % of the seedling crown is green but has a dead terminal shoot;
- E – 100 % of the seedling is dead.

Results

The first and the second assessments were made in 2005 and 2006 years, and survivals and dead seedlings were recorded; however, the survivals were not distributed on the A to D categories. At that time, the plantation average success (%) per species was very high, such as: 97 % in *P. cembra* and 95 % in *P. mugo* and *P. abies*.

The third monitoring was made from 27 to 29 of May, 2007, after snow melting by using the previously mentioned five steps scale. According to this inventory made in the 10 check plots, the following results were obtained:

•the average survival seedlings for cembra pine was as much as 96.3 % but the percent survival varied from plot to plot, i.e. from 93.6 % in plot nine and 100 % in plots number 6, 7, 8 and 10 (*Table. 1)*;

•for dwarf pine (*Table. 2*), the average survival was slightly lower (but still very high) than in cembra pine, i.e. 94.2 % and variation was between 92.3 % in plot number 4 and 100 % in plot one. The rowan planted in the same whole with the dwarf pine has 96 % survival.

In case of spruce (*Tab. 3*), the average planting success was 92.2 % and the variation was between 90 % in plot number 8 and 100% in some other five plots.

According to the Romanian legislation 85 % survival is accepted as good and very good over 90 %.

This very high survival owes not only to the species but also to the snow layer that protected the seedlings against frost during the winter period. Therefore, decreasing in survival in the coming years is expected. In addition, because of the snow layer protection, inferences concerning relationship between the survival and elevation, ca not be done at this age.

Concomitantly with the seedling inventory, observation on behavior or resistance to harsh climate conditions was made, and the conclusions on this subject are, as follows:

• as expected, the *P. mugo* exhibited the highest resistance to the harsh climate conditions from Pietrosul; however, in some sites exposed to the north-west winter winds, not only the planted but also the natural bushes are injured; about 1 % of planted seedlings have suffered;

• *P. cembra* is the next species with high level of hardiness but not so high as the former species; in some north-west wind exposed slopes, about 3 % of seedlings were affected by cool winter wind and some of these seedlings have recovered and some died;

• when planted above 1500 m elevation, *P. abies* exhibited highest susceptibility to the winter cool wind; about 8 % of seedlings were injured and most of them have died.

• *S. aucuparia*, is a not foreseen species in the project, but it was introduced as it is a basic species in the local habitats; it proved to be as resistant as the *P. mugo* species and survival was as much as 94%..

Conclusions

The year 2007 inventory showed that the survival was very high with the cembra pine in top, followed by dwarf and by spruce;

According to the Romanian Romsilva normative, a survival of 85 % in the first year of planting, is considered as good and very good over 90 %.

It is expected that later one, the survival will decreased.

The previously mentioned results are the first to be included in the plantation database;

As foreseen in The after LIFE Conservation Plan, data of evolution process will continually be recorded, at least up to the year 2010.

Decreasing in survival in the coming years is expected.

Inferences concerning relationship between the survival and elevation, ca not be done at this age.

A working restoration model to be used elsewhere can not be made yet.

At present healthy state of cembra and dwarf pine is good

Annex 4, Table 1. *Pinus cembra* seedlings distribution per check plots and health categories

Plot (No.)	Elevation (m)	A	B	C	D	Survival	E	Total	A	B	C	D	Survival	E	Total
		Number of seedlings per plot*							In percents						
1	1801	65	3	0	0	68	4	72	90.3	4.2	0.0	0.0	94.4	5.6	100.0
2	1719	36	2	0	0	38	2	40	90.0	5.0	0.0	0.0	95.0	5.0	100.0
3	1695	28	2	0	0	30	1	31	90.3	6.5	0.0	0.0	96.8	3.2	100.0
4	1822	6	2	1	0	9	1	10	60.0	20.0	10.0	0.0	90.0	10.0	100.0
5	1711	34	2	1	0	37	2	39	87.2	5.1	2.6	0.0	94.9	5.1	100.0
6	1630	29	1	0	0	30	0	30	96.7	3.3	0.0	0.0	100.0	0.0	100.0
7	1649	48	3	0	1	52	0	52	92.3	5.8	0.0	1.9	100.0	0.0	100.0
8	1651	41	2	1	1	45	0	45	91.1	4.4	2.2	2.2	100.0	0.0	100.0
9	1673	83	3	2	0	88	6	94	88.3	3.2	2.1	0.0	93.6	6.4	100.0
10	1651	14	2	0	0	16	0	16	87.5	12.5	0.0	0.0	100.0	0.0	100.0
Total		384	22	5	2	413	16	429	89.5	5.1	1.2	0.5	96.3	3.7	100.0

*The plot radius was as much as 13 m

Annex 4, Tab.2. *Pinus mugo* seedlings distribution per check plots and health categories

Plot (No.)	Elevation	A	B	C	D	Survival	E	Total	A	B	C	D	Survival	E	Total
		Number of seedlings per plot*							In percents						
1		1	0	0	0	1	0	1	100	0	0	0	100.0	0.0	100
2		72	1	0	0	73	4	77.0	93.5	1.3	0.0	0.0	94.8	5.2	100
3		39	0	1	0	40	2	42.0	92.9	0.0	2.4	0.0	95.2	4.8	100
4		38	6	3	1	48	4	52.0	73.1	11.5	5.8	1.9	92.3	7.7	100
5		0	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
6		0	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
7		0	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
8		0	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
9		0	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
10		0	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
Total		150	7	4	1	162	10	172.0	87.2	4.1	2.3	0.6	94.2	5.8	100

*The plot radius was as much as 13 m

Annex 4, Tab. 3 *Picea abies* seedlings distribution per check plots and health categories

Plot		Number of seedlings per plot*							In percents						
(No.)	Elevation	A	B	C	D	Survival	E	Total	A	B	C	D	Survival	E	Total
1		8	6	6	2	22	3	25.0	36.4	24.0	24.0	8.0	92.4	12.0	104.4
2		4	2	0	0	6	0	6.0	66.7	33.3	0.0	0.0	100.0	0.0	100.0
3		1	0	0	0	1	0	1.0	100.0	0.0	0.0	0.0	100.0	0.0	100.0
4		1	0	0	0	1	0	1.0	100.0	0.0	0.0	0.0	100.0	0.0	100.0
5		42	17	2	1	62	5	67.0	62.7	25.4	3.0	1.5	92.5	7.5	100.0
6		66	9	0	0	75	6	81.0	81.5	11.1	0.0	0.0	92.6	7.4	100.0
7		25	5	1	3	34	3	37.0	67.6	13.5	2.7	8.1	91.9	8.1	100.0
8		3	4	2	0	9	1	10.0	30.0	40.0	20.0	0.0	90.0	10.0	100.0
9		1	0	0	0	1	0	1.0	100.0	0.0	0.0	0.0	100.0	0.0	100.0
10		2	**1**	0	0	3	0	3.0	66.7	33.3	0.0	0.0	100.0	0.0	100.0
Total		153	44	11	6	214	18.0	232.0	65.9	19.0	4.7	2.6	92.2	7.8	100.0

*The plot radius was as much as 13 m