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improvement" (SALVERE)

Work package 6
Report 1

by

AREC Raumberg-Gumpenstein

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1 Introduction

A characterisation and a map of the experimental and the demonstration site and the activities of work packages 6 are described below. For all sites, the involvement in the different actions is indicated. The project partner 2 (AREC Raumberg-Gumpenstein) is involved in the following actions:

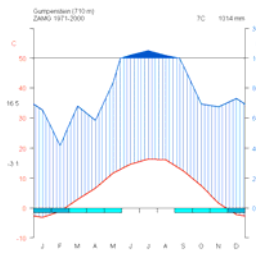
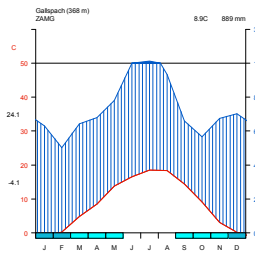
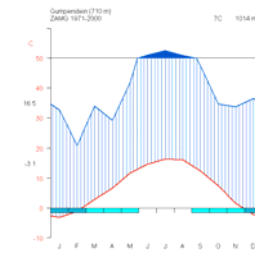
Work package 6 Establishment of new High nature value Farmland

- ⇒ assessment of the effectiveness of different propagation material in restoring HNV areas in different types of degraded sites
- ⇒ demonstration of the effectiveness of different propagation material in restoring HNV areas in different types of degraded sites
- ⇒ convincing of stakeholders of the benefit of the methods and transfer of knowledge into practice (not part of this report)
- ⇒ synopsis and evaluation of information regarding the establishment of HNV areas (not part of this report)

2 Overview and characteristics of study sites

2.1 Description of the experimental and demonstration sites

Project partner	2	2+3	2
Country	Austria	Austria	Austria
Type of target community	Arrhenatherion	Arrhenatherion	Molinion
Type of degraded land	grassland	flood detention basin	fresh meadow
Type of trial	experimental	demonstration	demonstration
Involved in Action	WP4, WP5, WP6	6.2	6.2
Year of implementation	2009	2009	2007
Description of the site			
Location	experimental site GUM II-B	Stillbach (Upper Austria)	Weissenbach golf course
Natural landscape unit	Ennstal valley, on a glacial terrace	artificial invested area	Ennstal valley, on a glacial terrace
Longitude (° from Greenwich)	47° 29' 41" N	48° 14' 05" N	47°33'25" N
Latitude (°)	14° 06' 05" E	13° 43' 03" E	14°11'43" E
Altitude (m s.l.m.)	c. 740 m a.s.l.	c. 363 m a.s.l.	654 m ü. A.
Aspect (0 °= North, 90 °= East,...)	plain	plain	plain
Slope (%)	0	50	0
Extension (Approx.)	25 m x 90 m	20 m x 156 m	1 ha
Geology	northern limestone alps, east alps	Molassezone, fluvial terraces, tertiary accumulation gravel, sand, clay	northern limestone alps, Palaeozoic greywacke and crystalline schist; Werfner strata with gypsum deposits
Description of the climate			
Mean yearly rainfall (mm) 1971-2000	1014,1 mm	889,4 mm	1014,1 mm
Mean rainfall in spring, summer, autumn and winter (mm) 2007	192, 162, 344, 178	252, 166, 150, 219	242, 271, 543, 232

Mean yearly temperature (°C)	7°C	8,4°C	7°C
Mean date begin vegetation period (mean daily temperature 5°C for sequently five days)	24.März	19.März	25.März
Mean date end vegetation period (mean daily temperature 5°C)	3.November	6.November	4.November
Mean length of vegetation period	307	310	308
Climate chart			
Type of soil preparation	Seed production (06/08, 08/09), "Regolen" in Mai 2009, ploughing	straw mulching with bitumen ("black-green system")	mulching, ploughing, levelling

Photographs



Figure 1: Location of receptor site on the flood detention basin Stillbach (Upper Austria).

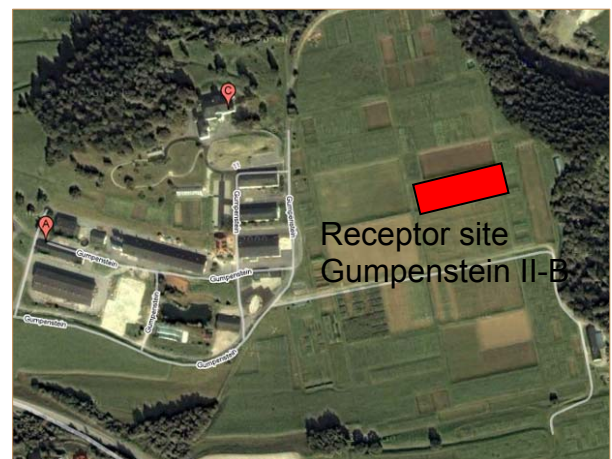


Figure 2: Location of the receptor site in Gumpenstein; Ennstal valley

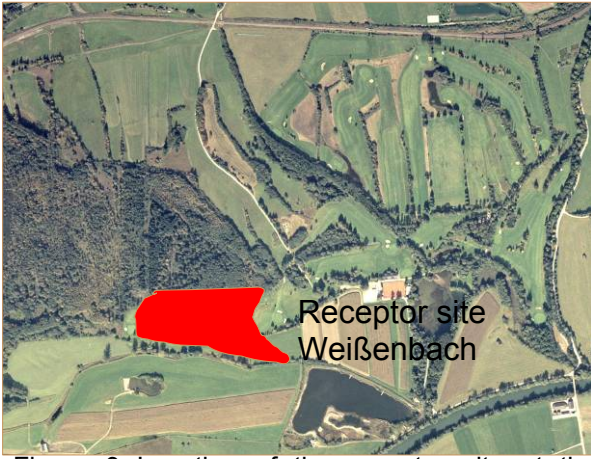


Figure 3 Location of the receptor site at the golf course Weißenbach

2.2 Design of experimental and demonstration trials

All experimental and harvesting trials are realised in block design to allow statistical analyses. The demonstration trials (only receptor site) are applied without replication. The experimental trial was restored in the beginning of July.

2.2.1 Design of experimental trial GUM/II-B at the AREC Raumberg-Gumpenstein

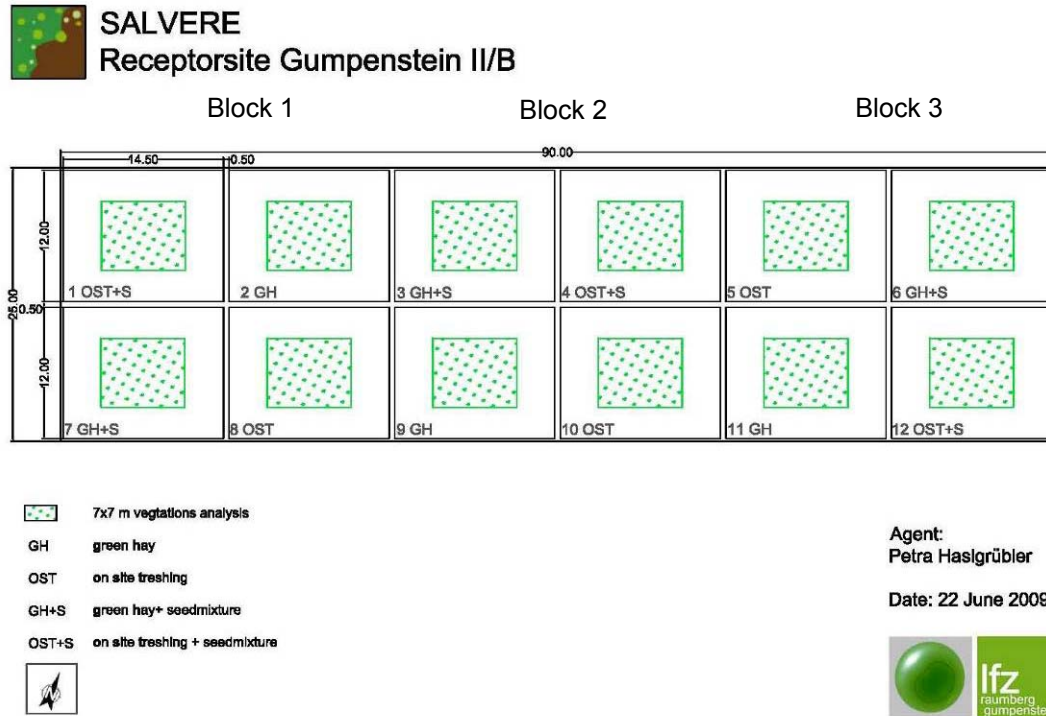


Figure 4: Map of the experimental site Gumpenstein II-B

The materials from the donor site (Arrhenatherion - grassland from the Welser Heide) are used to apply the experimental site Gumpenstein II-B. The donor site was harvested in July 2009. The green hay-variant was implemented immediately after cutting on the experimental site. The on-site threshing material was applied on the 25.08.2009.

	GH	GH+S	OST	OST+S
replicants	3	3	3	3
Trial size [m ²]	174	174	174	174
Compulsary methods	x		x	
Voluntarily methods		x		x
seed mixture/m ² [g]		2.5	3	1.5 + 1.5
seed density donor:receptor	1:2.6	1:2.6		
date of sowing	01.07.2009	01.07.2009	25.08.2009	25.08.2009

2.2.2 Design of demonstration trial on the flood detention basin Stillbach

Different types of soil are used for the construction of the flood detention basin. The flood detention basin was vegetated on the 16 April 2009. The area was sown via hydroseeding, consisting of a mixture of seed-rich material from on-site threshing with additional sowing of commercially propagated species from regional origin. The seed rich material from on site threshing was originated from the Welser Heide. Because of the early setup in April 2009, the material from the harvest 2008 had to be used.

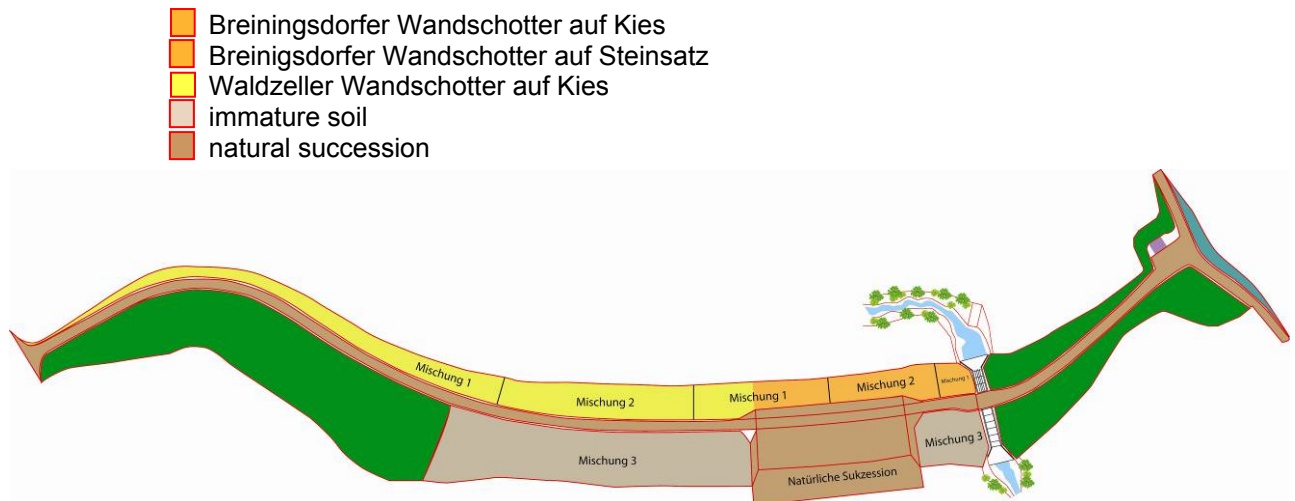


Figure 5: Map of the demonstration site Stillbach

Trial size	161 m ²
Compulsory propagation materials	OST+S
Seed density	2 -3,5 g/m ²
Date of sowing OST+S	16.04.2009

Top soil (humus or compost) was not implemented on the detention area because the percentage of the fine fraction of the different gravel types was high enough. Different samples of seed mixture are

- Sample area I semi dry grass and mixture (AV1)
- Sample area II poor grass and mixture (BM1)
- Sample area III Tall oat grass meadow (AV2)

Table 1: different types of seed samples AV1, BM1, AV2

Sample area I (AV1)	GW-%	Sample area II (BM1)	GW-%	Sample area III (AV2)	GW-%
<i>Festuca nigrescens</i>	35	<i>Arrhenatherum elatius</i>	10	<i>Festuca nigrescens</i>	17
<i>Festuca rupicola</i>	18	<i>Avenula pubescens</i>	8	<i>Arrhenatherum elatius</i>	15
<i>Bromus erectus</i>	10	<i>Festuca nigrescens</i>	6	<i>Avenula pubescens</i>	10
<i>Briza media</i>	2	<i>Lolium multifl. var. westerwoldicum</i>	5	<i>Bromus erectus</i>	20
<i>Lolium multifl. var. westerwoldicum</i>	5	<i>Bromus erectus</i>	7	<i>Briza media</i>	2
<i>Leucanthemum vulgare</i>	2	<i>Briza media</i>	1	<i>Lolium multifl. var. westerwoldicum</i>	5
<i>Anthyllis vulneraria</i>	3	<i>Leucanthemum vulgare</i>	8	<i>Leucanthemum vulgare</i>	2
		<i>Anthyllis vulneraria</i>	3	<i>Anthyllis vulneraria</i>	3
				<i>Knautia arvensis</i>	1
seed rich material from OST	25	seed rich material from OST	52	seed rich material from OST	25
	100		100		100

Application technique: hydro-seeding plus straw-mulch

Hydro-seeding combined with covering the topsoil with a layer of straw-mulch was used. In this seeding method seeds, fertiliser, soil adjuvant substances and gluten are mixed with water in a special spray container and sprayed over the areas to be restored. Even steep banks with a smooth surface can be restored in this way, whereby the rapid emergence of the seed has above all proved to be advantageous against erosion processes.

Table 2: material expenditure of the hydroseeding for the different types of seed samples

Sample area I (AV1)		Sample area II (BM1)		Sample area III (AV2)	
Composition per half area ca. 2500 m ²		Composition per half area ca. 2500 m ²		Composition for 4350 m ² area	
35 kg	AV 1 = mixture 1/ semi dry turf	35 kg	BM 1 = mixture 2/ pure grassland	75 kg	AV 2 = mixture 3/ Arrenatherum meadows
50 kg	15 : 15 : 15 = Vollkorn yellow	50 kg	15 : 15 : 15 = Vollkorn yellow	100 kg	15 : 15 : 15 = Vollkorn yellow
25 kg	Recuform 38% N	25 kg	Recuform 38% N	25 kg	Recuform 38% N
400 l	Turf	400 l	Turf	500 l	Turf
15 kg	Cellugrün	15 kg	Cellugrün	30 kg	Cellugrün
1,5 kg	Proterra 2000/glue	1,5 kg	Proterra 2000/glue	2,5 kg	Proterra 2000/glue
140 kg	Provide Verde 4,4% N	140 kg	Provide Verde 4,4% N	120 kg	Provide Verde 4,4% N
500 g	Straw	500 g	Straw	500 g	Straw

2.2.3 Design of demonstration trial of Weißenbach

Site description

- 3 donor areas and receptor areas
- Inclination: plain
- Date of harvesting the donor areas: September, 5, 2006
- Date of set up the restoration areas: November 2006

Soil parameters

- pH of receptor areas: 5.9 – 6.9

Variant S1 - *Molinia caerulea* rich litter meadow

- Seed density: 2.5 g/m²
- Application technique: sown by seeder
- Monitoring plot: 1 – 4 (36m² per plot)

Variant S2 – Litter meadow with tall sedges

- Seed density: 2.0 g/m²
- Application technique: sown by seeder
- Monitoring plot: 5 – 8 (36m² per plot)

Variant S3 - *Iris sibirica* rich litter meadow

- Seed density: 3.5 g/m²
- Application technique: sown by seeder
- Monitoring plot: 9 (36m² per plot)



- S 1 *Molinia caerulea* rich litter meadow
- S 2 Tall sedge swamp
- S 3 *Iris sibirica* rich litter meadow
- Areas of natural succession
- 6x6m Monitoringareas

Figure 6: Location of the receptor site Weißenbach in the Ennstal valley with the 9 monitoring areas

2.3 Soil survey for all sites

The soil samples of the experimental and demonstration sites will be analysed in order to assess its physical and chemical properties and its fertility. At plot level, soil samples were collected in two layers (0-10 and 10-20 cm) and will be analysed in the laboratory.

Table 3: Parameters which are analysed from all sites

Description of the soil	Results
Gravel (%)	in progress
Sand (%)	in progress
Lime clay (%)	in progress
pH (in water/CaCl ₂)	in progress
Organic matter content (%)	in progress
Total Carbonate (mass-%)	in progress
Total Nitrogen (according to national rules) (mass-%)	in progress
Total Phosphorus (mass-%)	in progress
Total Potassium (mass-%)	in progress
Plant available phosphorus mg per 100 g soil	in progress
Plant available magnesium mg per 100 g soil	in progress
Plant available potassium mg per 100 g soil	in progress

3 Methods Work package 6

3.1 Assessment of the effectiveness of different propagation material in restoring HNV areas in different types of degraded sites

3.1.1 Propagation material of the experimental site Gumpenstein II-B (see figure 4)

Compulsory propagation materials

- OST sowing of seed-rich material from on-site threshing (3 g/m²) from the first cut in summer
GH application of approx. 1.5 kg (3 – 5 cm) freshly mown plant material in a ratio of 1:2.6 donor:restoration area (“green hay”) from the first cut in summer

Voluntary propagation materials

- OST + S sowing of seed-rich material from on-site threshing 1.5 g/m² with additional sowing of commercially produced species; seed of regional origin from seed propagation with 1.5 g/m²
GH + S Application material is approximately 1.5 kg freshly mown plant material in a ratio of 1:2.6 donor:restoration area (“green hay + seed mixture”) with an additional seed mixture of commercially produced species. Seed material is used of regional origin with seed propagation of 2.5 g/m².

3.1.2 Specifications for harvesting and implementation

Date of harvesting

- The donor site was harvested on the 1st of July. All methods were cut at the same time to allow a comparison between different methods.

Date of implementation

- green hay (GH): application of the material on the receptor trials was implemented immediately after cutting at the harvesting date
- on-site threshing material (OST): application of the material on receptor trials was on the 25.08.2009, following the right weather conditions.

Management after restoration

In the year of application the Green hay variants were cut after two moths on the 16.09.2009 to control unwanted weeds. The OST and OST+S did not need a cut because of the late set up. In the following years, the area will be cut at least once, depending on the usual management of the specific community.



Figure 7: Three pictures from the implementation in July 2009 until now (4 month later, November 2009) where the GH and the GH+S is covered with snow.

3.2 Demonstration of the effectiveness of different propagation material in restoring HNV areas in different types of degraded sites

3.2.1 Flood detention basin Stillbach

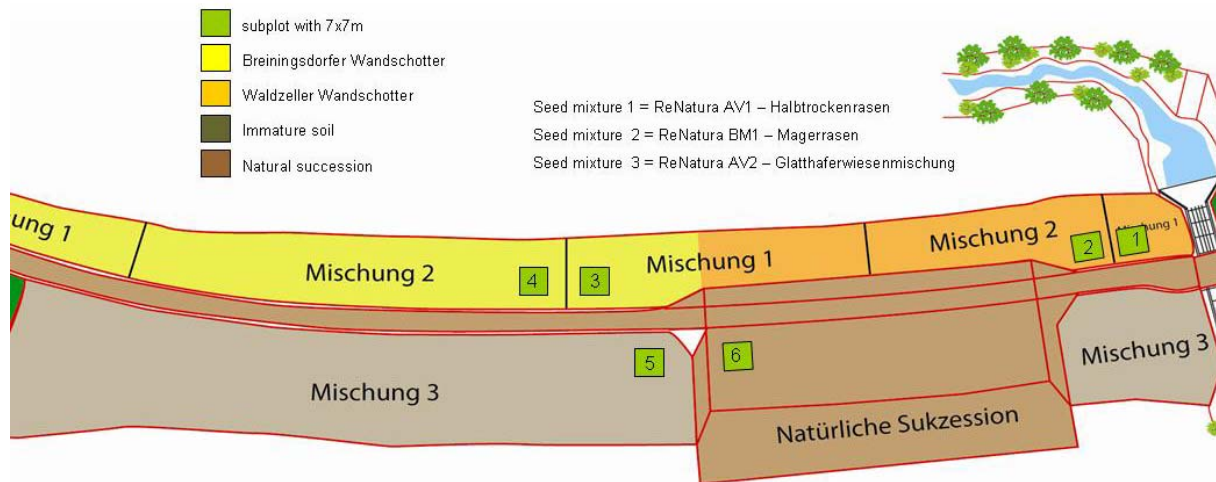


Figure 8: Different types of soil/gravel are used for the construction of the flood detention basin

OST + S sowing of seed-rich material from on-site threshing 3.5 g/m² with additional sowing of commercially produced species; seeds of regional origin from seed propagation with 2.5 g/m²

□ subplot with 7 m x 7m

3.2.2 Specifications for harvesting and implementation

Date of harvesting

- The donor site (Welser Heide) was harvested in 2008.

Date of implementation

- on-site threshing material: application of material on receptor trials was on the 16 April 2009 with hydro seeding

Management after restoration

This year a cut was not necessary because of the different gravel variants and the extensive seed mixtures AV1, AV2 and BM1. The percentage of unwanted vegetation was very low using a cover crop *Lolium multiflorum*. This grass species is annual and will be gone by next year. In the years after set up the area will be cut at least once depending to the usual management of the community.



Figure 9: Three pictures from the implementation till the greened dam.

3.2.3 Golf course Weißenbach

The demonstration site at Weißenbach was set up on the 30 Nov. 2006. The reason for the late restoration in the winter was because *Iris sibirica* needs frost to germinate. After the implementation with on-site threshed material of the site a cleaning cut in June 2007 was necessary to control the unwanted weeds. 9 Monitoring plots with a size of 6x6 m were implemented to do vegetation analysis. This year the vegetation analysis was done in July.

OST sowing of seed-rich material from on-site threshing (ca. 3.5 g/m²) from the first cut in summer

4 First Results of the vegetations analysis

4.1 Experimental site Gumpenstein

As already mentioned the first vegetation analysis of GH and GH+S on the experimental trial in Gumpenstein was done on 16.09.2009. A species list was created and the percentage of grasses, herbs and legumes were estimated. The following figure will show the first results of the year 2009.

The proportion of grasses is higher than that of herbs and legumes. With one exception on the field 6 GH+S the percentage of the grasses is lower. It is evident that the average of herbs and legumes on the variants with the seed mixture is higher than on the other ones. The green hay was very seed rich with herbs and legumes but through the thick mulch layer the grasses had a big advantage to develop instead of the herbs and the legumes.



Figure 10: Vegetations analysis in Gumpenstein on 16.09.2009

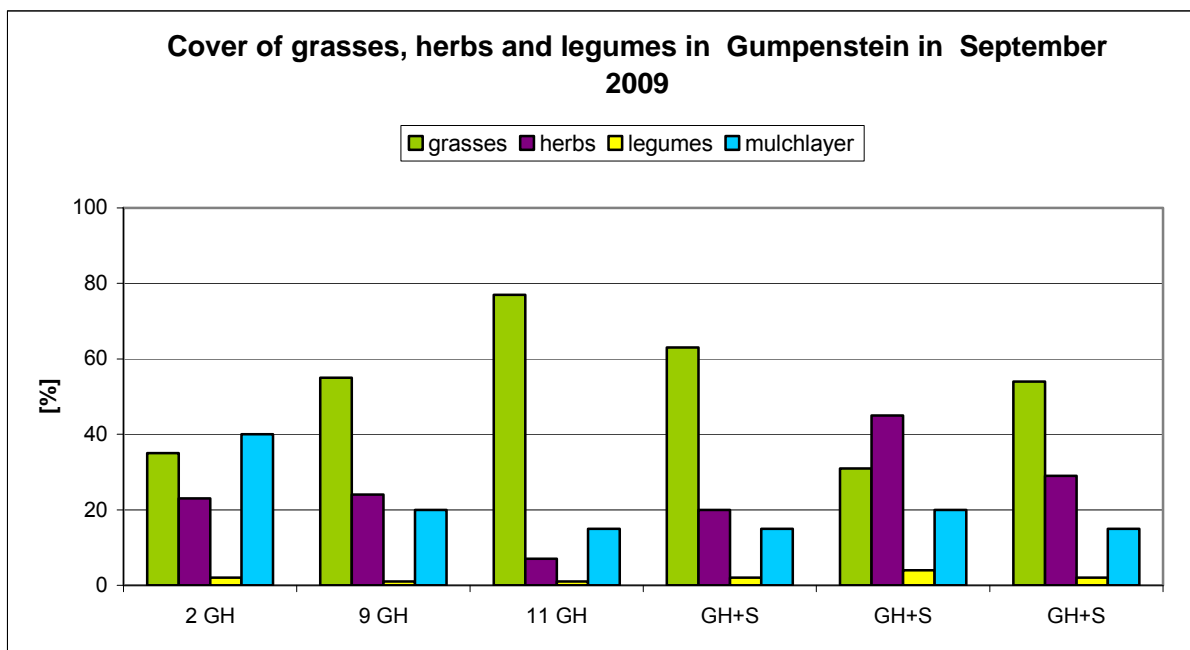


Figure 11: Cover of the green hay variants on the experimental site in Gumpenstein from the vegetation analysis in September 2009

4.2 Demonstration site the flood detention basin in Stillbach

The flood detention basin was set up in April 2009. Three different seed mixtures and two gravel mixtures were used. The first vegetation analysis was done in October 2009. Showing only marginal vegetation just a species list was made. An exact botanical survey will be done next year. Surprisingly no cleaning cut was necessary. Through the gravel mixtures and the extensive seed mixture the amount of the biomass was very low, also no unwanted weeds were found. If it is necessary, a cultivation concept will be worked out next year.



Figure 12: Three different views on the flood detention basin in Stillbach. The first view is on immature soil with the seed mixture ReNatura AV2. The second view is on top of the dam where lanes from cars and vegetation are visible. The third view is on Breiningsdorfer and Waldzeller gravel with different seed mixtures AV1 and BM 1

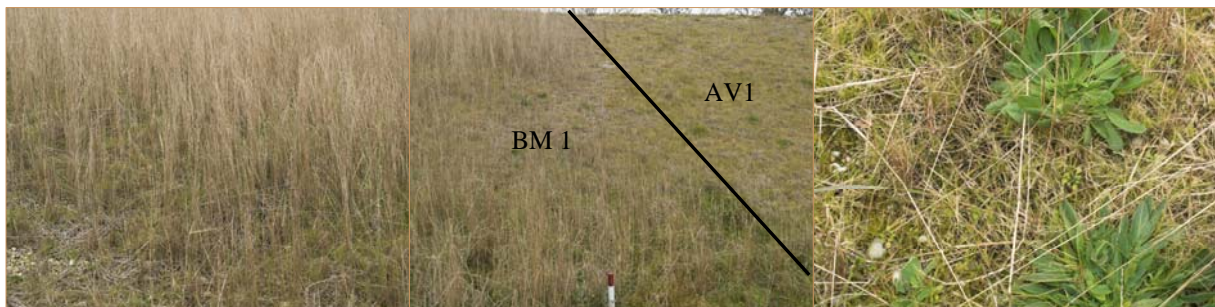


Figure 13: Details of the vegetation on the flood detention basin. First is the cover crop *Lolium multiflorum* in the middle is the difference between two seed mixtures BM1 and AV1 and on the right site is a detail of *Anthyllis vulneraria*

4.3 Demonstration site Weißenbach

The Demonstrations site was set up 2006. The first vegetation analysis was done 2007. Every year a vegetation survey and a species list will be created. Figure 15 shows a comparison of the seed mixture from a *Molinia caerulea* rich meadow on the fields 1-4. It is obvious that the legumes have a decline in comparison to the other two years. The percentage of grasses and herbs is rising.

The fields 5 - 8 are a tall sedge swamp. The portion of herbs is almost doubling in comparison to the other years. The fraction of grasses is rising in the field 5, 6 and 8. The fraction of herbs and grasses on field 7 are almost the same. This is because of the underground, the other fields are flooded. The cut of the legumes is deteriorating.

The field number 9 is an *Iris sibirica* rich meadow. The coverage of the whole vegetation rises slowly, as those kinds of meadows are growing slowly.

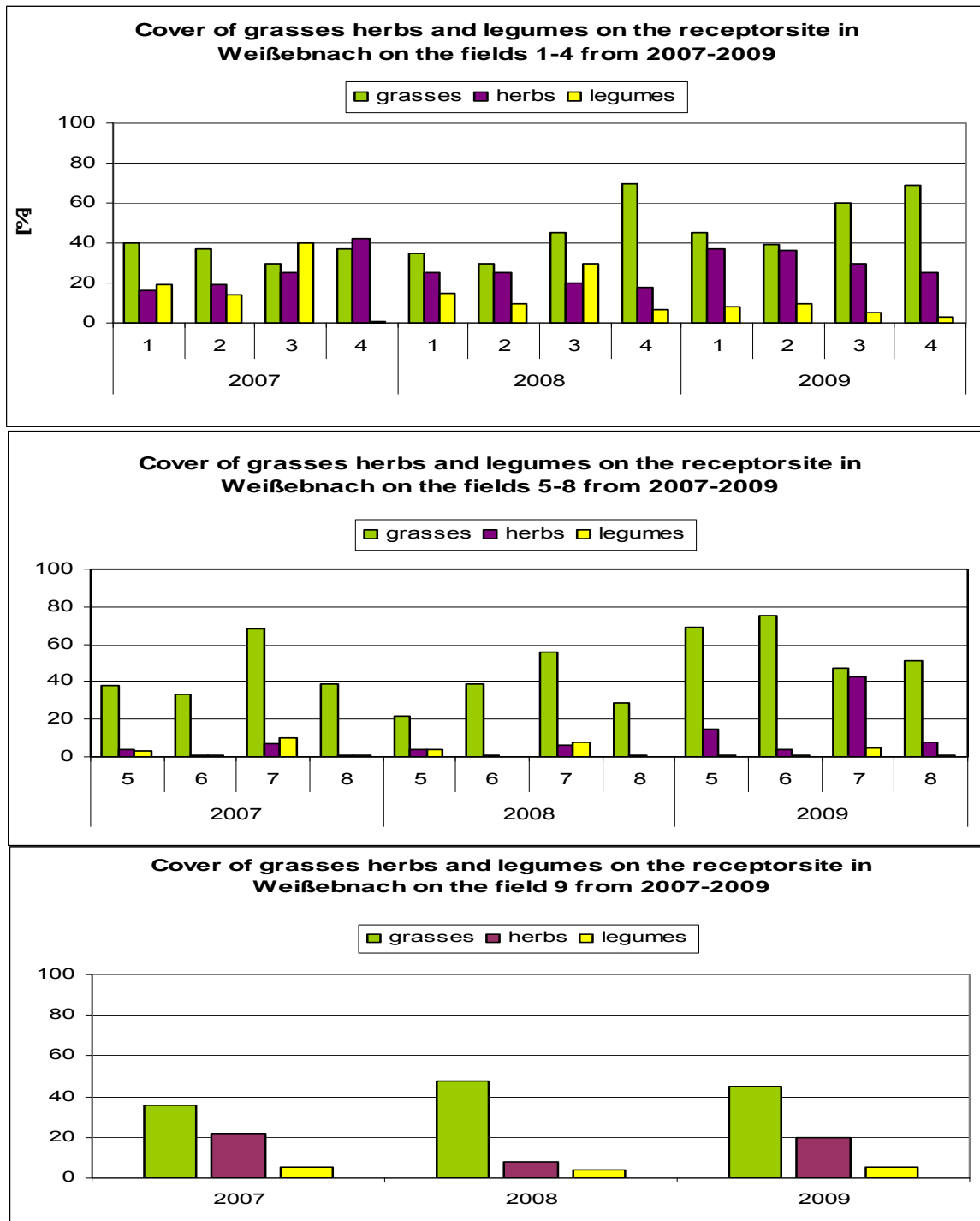


Figure 14 - 15: The three figures show the development of the coverage of grasses, herbs and legumes of the receptor site in Weißenbach in a time laps from 2007 to 2009.

