

Data on the mowing of traditional hay meadows in the SCI “Eastern Hills of Cluj” (Transylvania, Romania)

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DBU: www.dbu.de

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1. Introduction, aims and methodology of the study

1.1. The traditional hay meadows in the SCI “Eastern Hills of Cluj”

Hay meadows are mesophilic or hygrophilic grasslands that are cut regularly in order to produce winter fodder for livestock in form of hay. Low-intensity hay meadows have existed in Europe since the Bronze and Iron Ages (Dierschke & Briemle 2008). The management activities influence the floristic and structural composition of the meadows: low-intensity land use practices (e.g. no/low degree of fertilisation, one to two annual cuts) produce more valuable habitats than the intensive modern grassland management in terms of biodiversity, rare species richness and attractiveness as landscape elements (Oppermann et al. 2012).

However, the traditional and extensively used meadows are highly threatened throughout Europe and have suffered considerable declines during this and the last century. The main causes of this have been conversion into arable land, intensification to create more productive grasslands or the abandonment of agricultural management on less productive sites (Dierschke & Briemle 2008).

While these developments have been affecting semi-natural grasslands (i.e. both meadows and pastures) since the 1960s in many parts of Western Europe (e.g. Poschod et al. 2005, Ellenberg & Leuschner 2010), the large-scale loss of High Nature Value grassland is a relatively new phenomenon in Central and Eastern Europe, where large areas of species-rich farmland can still be found (Liira et al. 2008).

Apart from the serious loss of highly biodiverse meadows in Eastern European countries like Romania, there is also the problem of lacking information about the quantity and quality of semi-natural grasslands as well as about the extent of the ongoing decline. With this study we provide evidence on the extent of semi-natural hay meadows and changes to this area during the last decade in a Natura 2000 area in north-western Romania.

The studied Site of Community Interest (SCI) “Eastern Hills of Cluj” (figure 1) extends over a surface of 24,000 ha northeast of the city of Cluj and includes 9 communes (see figure 2).

In the communes of Borșa and Dăbâca, part of the SCI, the grassland vegetation and main land use types were mapped in 2011. The study revealed that around one third of the grassland area is or has until recently been used as hay meadows (Paulini et al. 2012). They belong to the following phytosociological vegetation units (Paulini et al. 2011; Paulini et al. 2012):



- semi-dry sub-continental meadow-steppes (Cirsio-Brachypodium), often with small patches of intermittently wet meadows (Molinion caeruleae)
- mesic, nutrient-rich meadows (Cynosurion cristati)
- meso-hygrophilous flood plain meadows (Agrostion stoloniferae)
- oatgrass meadows (Arrhenaterion elatioris)

A remarkable feature in these grasslands are the so-called traditional “hay meadow complexes”, meadow sites of ca. 10 - 300 ha which are characterized by a long continuity of use as hay meadows. We call them complexes, because they are characterized by a recurrent pattern of different grassland types, but also fringe communities and single shrubs, trees and groups of shrubs. Moreover, they are divided in many ownership parcels (at least in Borșa and Dăbâca communes), which creates a heterogeneous land use pattern in space and time, and therefore contributes to the high biodiversity of these meadows (see also Huband 2008).

Where the traditional meadows are still in use, they are not fertilized, and mown once, seldom twice, a year. Mowing is now mainly carried out by tractor, but some parcels are mown by hand with scythes. In Borșa and Dăbâca communes, small hand mowing machines have also been used since 2012.

The traditional hay meadow complexes harbour some extraordinary examples of high nature value: the only known co-occurrence of all European species of the genus *Maculinea* (Rákosy & Vodă 2008), and the world record of plant species richness on small scales (at 0.1 and 10 m²) (Wilson et al. 2012). However, these “hot spots” are in danger, mainly due to the long-term abandonment of mowing, the increase of sheep grazing in summer and changes in the mowing management (e.g from hand cutting to tractor mowing).

According to the local farmers, the whole surface area of the meadows has been mown as long as they can remember (although in a heterogeneous pattern) while the abandonment of mowing is a new phenomenon of the last 2 decades. Whilst the abandonment is visible to any observer, its extent has not been quantified yet in the area.

1.2. Questions to be answered

1. Are the areas classified in the past (1960/70s) as hay meadow still used as hay meadows? If not, what is the new land use?
2. How much of the hay meadow surface was mown in 2012? Do the meadows differ in the proportion mown?
3. Are there trends regarding the shape of the mown plots?

1.3. Methodology

- To identify the hay meadows documented before 1990 we used land use maps from the 1960s/70s (scales 1:5,000 and 1:25,000) from the Agency of Cadastre and Land Registration Cluj (OCPI), which we georeferenced in ArcGIS. In these maps we delimited the so-called **Former Hay Meadow Complexes** (FHMC), which we define as hay meadow complexes as they occurred during the 1960/70s. Smaller, single meadow parcels were not considered in this study.
- In the second step, we delimited the hillside areas where all the mown parcels should be mapped, called **Mapping Polygons** (MP), which partly also encompassed areas outside the Former Hay Meadow Complexes. The mapping in these areas should reveal if mowing has moved away from the traditional hay meadows to other areas.
- Mapping of all the mown parcels in the Mapping Polygons (MP) was carried out in the field between October and December 2012 by 3 mappers using GPS devices.
- The gathered data was used to draw maps of the mown plots and carry out a statistical analysis.

2. Results

2.1. The Mapping Polygons and Former Hay Meadow Complexes

The Mapping Polygons (MP) were delimited according to the location of the Former Hay Meadow Complexes as well as geographical features (hillslopes, roads). Figure 2 shows the 5 studied MPs. They are all located on the northern slopes of the ridges stretching from west to east, indicating that this was the preferred location for hay meadows.

Some of the MPs cover Former Hay Meadow Complexes (FHMC) as well as other land use units (like no. 1, 3) whereas some of them follow the borders of the FHMC almost exactly (e.g. no. 2, 4, 5).

The FHMC are units that differ from their surroundings through the land use (hay meadow versus other), geographical features (on their boundaries often the exposition changes) and also toponyms (i.e. place names). The FHMC units were established on basis of the land-use maps, satellite images, field observations and knowledge about local names. Being drawn subjectively, additional knowledge can in some cases lead to their improvement. In most cases the FHMC are composed of several to many ownership parcels and can contain also single small lots of other land use units (in most cases arable land).

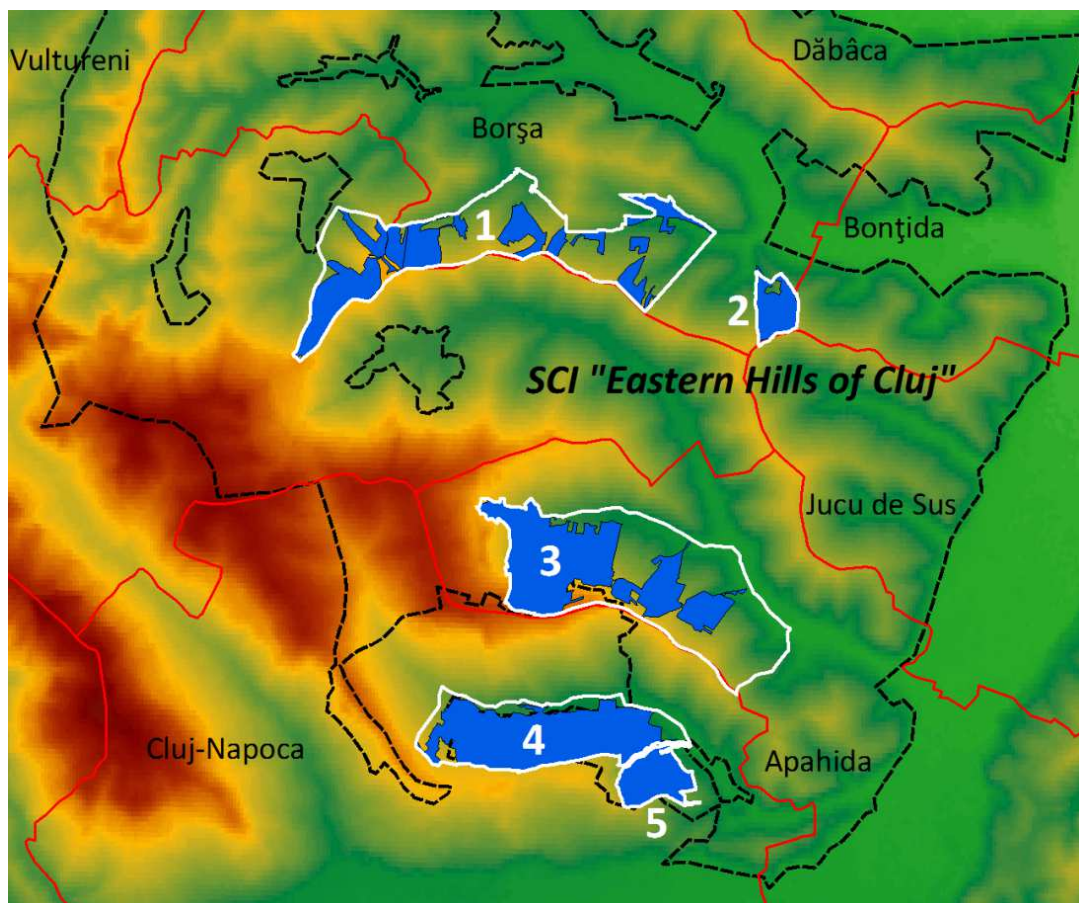


Figure 2: Overview map. White lines: Mapping Polygons; blue polygons: Former Hay Meadow Complexes; black dashed line: SCI Eastern Hills of Cluj; red lines & black names: communes. Numbers: 1: Meadows of Chinteni & Borșa, 2: 'Fanaia' Meadow, 3: Meadows of Apahida, 4: Meadows of Cluj, 5: Colonia Valea Calda Meadow. Sources: Background: SRTM-map Romania.¹; FHMC: based on land use map 1968, 1:25,000, Agency of Cadastre & Land Registration Cluj.

¹ <http://srtm.csi.cgiar.org>, see also Reuter et al. (2007) and Jarvis et al. (2008)

2.2. Mown parcels in 2012

In the following, the results will be presented separately for each Mapping Polygon (MP). In addition to the map of mown parcels, information about the size of the Former Hay Meadow Complexes and the mown area will also be provided. Furthermore, the FHMC are classified in three classes, indicating their current use:

- If less than 10% of the FHMC are mown, they are not considered as being a hay meadow any more. For the abandoned hay meadows, the new land use was recorded where possible.
- If up to one third of their surface is mown, they are considered “partly hay meadows”, especially if the mown part is clearly separated from the unmown part. In these cases, the delimitation should be reviewed based on more information.
- If more than one third of their surface is mown or the mowing occurs in patches over the whole area, the Former Hay Meadow Complexes are considered actively used hay meadows.

2.2.1. Meadows of Chinteni and Borșa

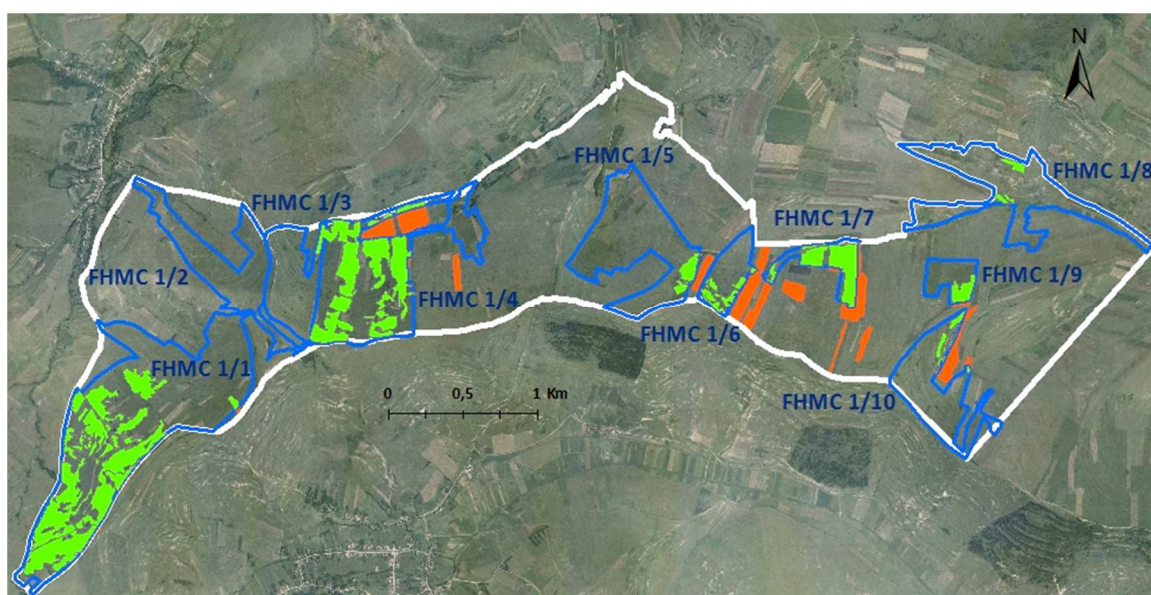


Figure 3: MP 1 with FHMC of Chinteni and Borșa communes and currently mown plots. White lines: MP; blue lines: FHMC; green polygons: parcels mown in 2012 inside FHMC; orange polygons: parcels mown in 2012 outside FHMC.

Table 1: Results for the hay meadows of Chinteni and Borșa.

FHMC No.	Area (ha)	Mown area (ha)	Mown area (%)	Still used as HM?	New Land use	Commune
1/1	111.0	38.1	34.3	yes	-	Chinteni
1/2	27.8	0.0	0.0	no	?	Chinteni
1/3	22.1	0.6	2.8	no	?	Borșa
1/4	57.2	23.4	40.9	yes	-	Borșa
1/5	42.2	2.0	4.8	no	?	Borșa
1/6	11.3	2.3	20.0	yes (partly)	-	Borșa
1/7	10.1	7.3	72.4	yes	-	Borșa
1/8	37.8	1.2	3.2	no	?	Borșa
1/9	8.0	1.8	23.0	yes (partly)	-	Borșa
1/10	26.6	1.4	5.4	no	sheep pasture	Borșa

2.2.2. 'Fânaia' Meadow

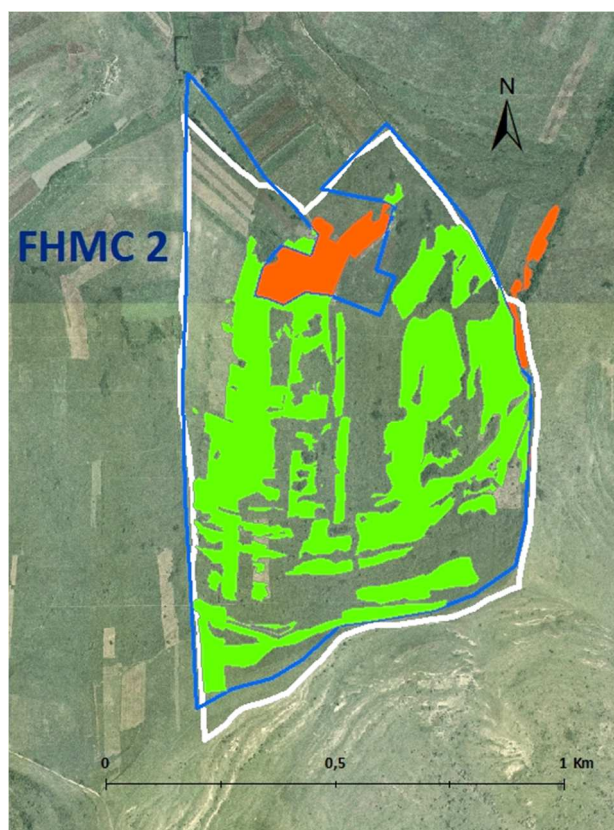


Figure 4: MP 2 with FHMC 'Fanaia' and currently mown plots.

White lines: MP; blue lines: FHMC; green polygons: parcels mown in 2012 inside FHMC; orange polygons: parcels mown in 2012 outside FHMC.

Table 2: Results for the hay meadow 'Fânaia'

FHMC No.	Area (ha)	Mown area (ha)	Mown area (%)	Still used as HM?	New Land use	Commune
2	68.7	29.0	42.3	yes	-	Borşa

2.2.3. The Meadows of Apahida

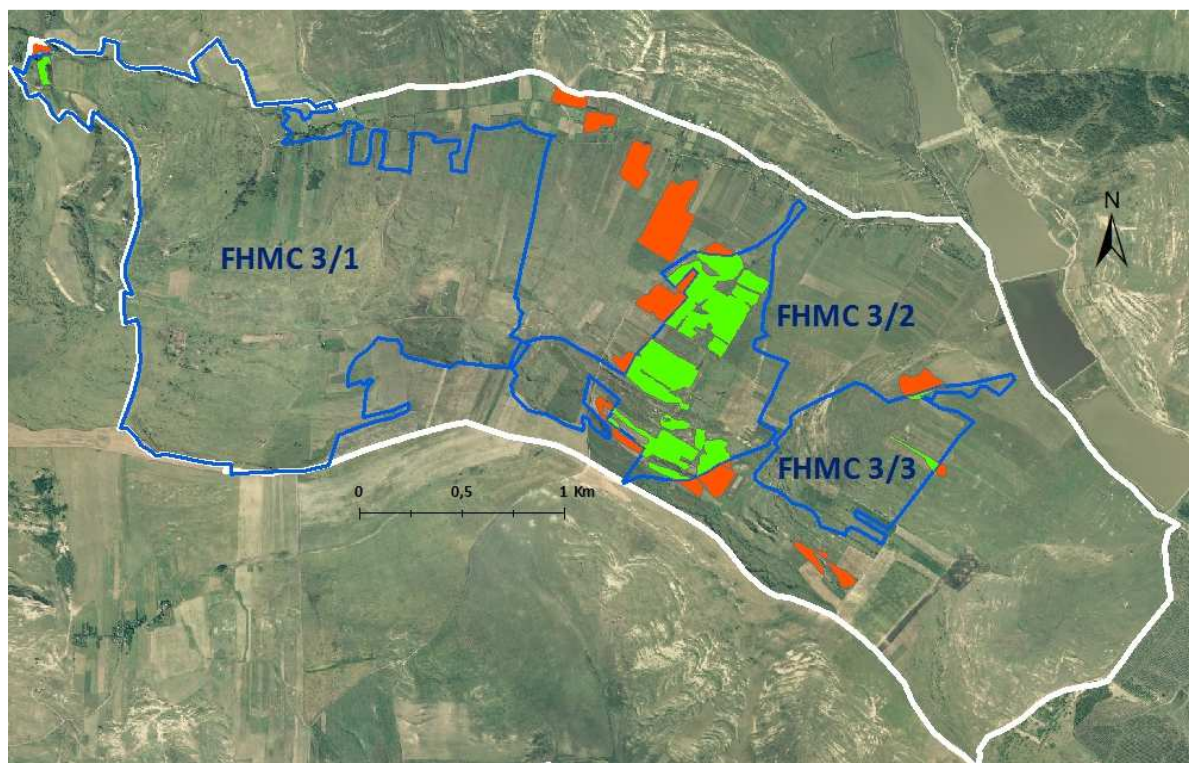


Figure 5: MP 3 with FHMC of Apahida commune and currently mown plots. White lines: MP; blue lines: FHMC; green polygons: parcels mown in 2012 inside FHMC; orange polygons: parcels mown in 2012 outside FHMC.

Table 3: Results for the hay meadows of Apahida commune

FHMC No.	Area (ha)	Mown area (ha)	Mown area (%)	Still used as HM?	New Land use	Commune
3/1	303.9	0.7	0.2	no	sheep pasture	Apahida
3/2	79.6	26.8	33.7	yes	-	Apahida
3/3	49.3	0.8	1.7	no	?	Apahida

2.2.4. The meadows of Cluj and Colonia Valea Caldă

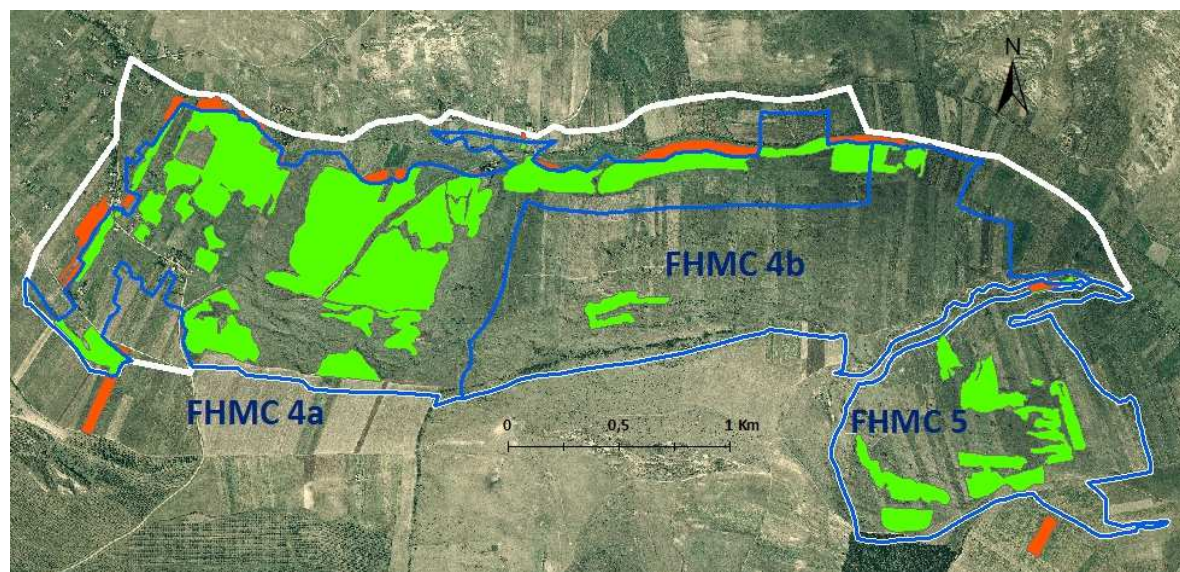


Figure 6: MP 4 and 5 with FHMC of Cluj and Colonia Valea Caldă and currently mown plots. White lines: MP; blue lines: FHMC; green polygons: parcels mown in 2012 inside FHMC; orange polygons: parcels mown in 2012 outside FHMC. The FHMC 4 was divided in two parts after the mapping, FHMC 4a and FHMC 4b, based on the obvious difference in the mowing activity. The line was drawn based on the delimitation of two hay meadow units in the land use map of 1968.

Table 4: Results for the hay meadows of Cluj and Colonia Valea Caldă

FHMC No.	Area (ha)	Mown area (ha)	Mown area (%)	Still used as HM?	New Land use	Municipality
4	383.5	97.5	25.4	yes (partly)	-	Cluj-Napoca
4a	225.0	92.3	41.0	yes	-	Cluj-Napoca
4b	158.5	5.3	3.3	no	sheep pasture, chalet	Cluj-Napoca
5	106.3	21.6	20.4	yes	-	Cluj-Napoca



Figure 7: FHMC „Valea Caldă”, July 2011, view facing N. In the background, tractor-mown parcels are visible, in the foreground there are fallow areas with *Calamagrostis epigejos* and *Phragmites australis*.

2.3. Analysis of the data

1. Are the areas classified in the past (1960/70s) as hay meadow still used as hay meadows? If not, what is the new land use?

About half (in number and surface) of the identified 17 Former Hay Meadow Complexes (FHMC) are still at least partly used as hay meadows, whilst the other half had been abandoned or had their management changed (see table 5). The maximum size of the biggest abandoned meadow is around 300 ha, this is also the meadow where the world record of plant species richness has been found (FHMC 3/1) (Dengler et al. 2012), rendering the abandonment even more alarming.

Table 5: Statistical analysis of the FHMC

FHMC class	No.	Max size (ha)	Min size (ha)	Area (ha)	Area (%)	Mown area (ha)	Mown area (%)
Still in use (yes)	7	225.0	10.1	657.9	48.9	238.5	36.3
Partly still in use (yes partly)	2	11.3	8.0	19.3	1.4	4.1	21.2
Not used as hay meadow (no)	8	303.9	22.1	668.3	49.7	12.1	1.8
SUM	17			1345.5	100.0	254.7	18.9

2. How much of the hay meadow surface was mown in 2012? Do the meadows differ in the proportion mown?

Around 250 ha of the total FHMC surface of 1350 ha was mown in 2012 (ca. 19%). In the areas of the FHMC which still are used as hay meadows, around one third of the area was mown on average; in the FHMC not considered any more as meadows only around 2 % was mown on average (table 5).

There are differences between the entirely or partly used meadows in terms of mown surface, which ranges in general between 20% and 40%. Only in one smaller Former Hay Meadow Complex of ca. 10 ha was more than two thirds of the surface mown (FHMC 1/7 in Borşa commune).

There are some cases in which the mowing activity has shifted from the FHMC to areas not formerly used as meadows, often located near to the FHMC outline (e.g. around FHMC 1/6 and FHMC 1/7 in figure 3 or between FHMC 3/1 and FHMC 3/2 in figure 5). Our observation suggest that the new locations for meadows are generally former arable land.

3. Are there trends regarding the shape of the mown plots?

In many cases it is visible that the mowing was carried out where the terrain was accessible by tractor (e.g. the horizontal mown plots in figure 4). In some cases the ownership parcels can be detected, which are often long, narrow strips of ca. 0.3 or 0.6 ha (also figure 4), often orthogonal to the level curves.

There still is a heterogeneous pattern of mown/unmown plots, which is promising for maintaining a high species diversity. However, there are also some big mown plots, like in FHMC 4a (figure 6), of 13 or even 18 ha (although it is possible that the big plots have been mown consecutively and not at once).

3. Conclusions

The results show that, compared to about 40-50 years ago, a considerable decline of the active use of the hay meadows has occurred, both in terms of completely abandoned hay meadows (half of the studied) as well as in terms of ratio mown / unmown surface. Based on farmers' statements that in general the entire hay meadow surface has been mown before 1990, we can conservatively estimate that the mown percentage ranged between 80 and 90%; in 2012 it ranged between 20 and 40% in most of the cases.

For three of the abandoned meadows it is known that the former meadow has been rented by sheep owners and is grazed nowadays. Furthermore, in some actively used meadows, conflicts between the shepherds and the farmers who wanted to mow were observed. While grazing to some extent prevents the succession of the abandoned grasslands to shrub formations (but only with sound management, including a suitable stocking rate), it changes the grassland structure and can lead to a decline of plant diversity (e.g. shown for subalpine meadows in Switzerland by Fischer & Wipf 2002) and the loss of typical meadow species. Studies are needed to examine the effects of grazing as well as mowing abandonment on the studied meadows.

Considering the importance of the traditional meadows on a national but also European level, it seems crucial to develop local protection strategies, especially as the meadows are inside a Natura 2000 area. The studied meadows, which in large parts have not been surveyed for their vegetation, flora and fauna yet, could even harbour other "surprises" like the above-mentioned species-richness records. The maps presented here can serve as the basis for the design of scientific studies as well as for nature conservation purposes. One approach could be to target conservation activities (given the limited resources available) on the meadows that are still actively used, provided that they also have a high nature value. Not least, the presented data shows the importance of developing well-targeted agri-environment programmes aimed especially at the protection of hay meadows.

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