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THE STATUS AND TRENDS OF THE SEMI-NATURAL GRASS COMMUNITIES IN THE FOREST BELT OF THE UKRAINIAN CARPATHIANS

*STAN I TRENDY PÓŁNATURALNYCH ZBIOROWISK ZIELNYCH
W PASIE LEŚNYM KARPAT UKRAIŃSKICH*

Slowa kluczowe: półnaturalne zbiorowiska, syntaksonomia, ochrona bioróżnorodności,
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Abstract. Centuries of mowing management in the forest belt of the Ukrainian Carpathians has led to the formation of semi-natural grass communities with species diversity higher than in the surrounding forest ecosystems. Among others, numerous protected plant species occur in these grasslands. Nowadays the abandonment of hayfields causes the expansion of scrub and forest and the decrease of open habitats in the mountains with negative consequences for biodiversity. The study made it possible to identify the phytosociological and ecological status of the semi-natural grasslands communities and develop recommendations for their sustainable use and conservation.

INTRODUCTION

Despite the global trend towards decreasing natural landscape areas, in some regions, particularly in the West of Ukraine, we can observe spontaneous recovery of forest communities in abandoned farmlands. In West-European countries, abandonment of agricultural land has taken place because of technological development combined with increasing off-farm employment opportunities arising from the industrialization and urbanization [Sanz et al. 2013]. On the contrary, in Ukraine the reduction of agricultural lands takes place due to the economic disadvantage of agricultural practices. However, this negative economic phenomenon, leads to the result which is the goal of environmental protection – the restoration of natural vegetation.

Human practices have had an impact on Carpathian forest ecosystems for a long time. Centuries of mowing management has led to the formation of semi-natural grass communities with species diversity higher than in the surrounding forest ecosystems (Fig.1, 2). In addition to natural, semi-natural plant communities

are also a source of biological diversity and subject to consideration of environmental protection. Many plant species protected by law occur in these grasslands. Semi-natural grasslands can also provide an important habitat for other groups of species. For example, 65% of the European Red List Butterfly species live in grassland habitats which are used for traditional farming [Van Swaay & Warren 1999]. Semi-natural grasslands can have also an important function for birds like the breeding birds Corn Crake, Lesser Grey Shrike, Lesser Spotted Eagle, Red Footed Falcon and White Stork which have strong populations in the Central and Eastern European countries compared with the Western European countries [Tucker & Evans 1997].

The Ukrainian Carpathians is a typical medium-sized mountain system. The climatic conditions are rather harsh in the highlands with high precipitation, a long winter season as well as varied mezo- and microclimates. The diverse geology and relief influence the richness and diversity of the vegetation cover. Five climatic-vegetation belts may be distinguished in the Ukrainian Carpathians [Malynovs'ky 1980]:

- The submontane belt of multi-species broadleaf forests (up to 300 m);
- The lower montane belt (the beech forests belt) (250-1,350 m);
- The upper montane belt (the spruce forests belt) (700-1,670 m) is developed mainly on northern mega-slopes of the mountains. At altitudes from 1,500 m upwards *Pinus cembra* L. occurs;
- The subalpine belt (1,300-1,850 m) is formed by dwarf shrub;
- The alpine belt (1,850-2,061 m) is developed from 1,850 m to the tops of the ridges and highest peaks.

The grasslands of the Ukrainian Carpathians have not been a matter of systematic scientific research over the last decades and our knowledge on their phytocoenotic structure, about the nature and scale of the changes are general and scarce. The available data on the diversity and distribution of the natural and semi-natural grasslands in this region is far from complete and the existing information is out of date. Recent changes in distribution of natural and semi-natural grasslands after the collapse of the soviet regime are not registered. Ukraine as a whole and the Ukrainian Carpathians in particular need urgently an inventory and mapping of the grassland vegetations in accordance to the European standards.

Now the abandonment of agricultural land is a widely observed trend in the Ukrainian Carpathians. It has led to the expansion of scrub and forest, to decrease of open habitats in the mountains that had negative consequences for biodiversity. So, a special emphasis has to be put on the biodiversity and status of plant communities and species of a conservation value. Additional assessment is necessary, concerning the statute of ownership and plans of the future use. All this is necessary in order to reach a system for adequate management and conservation of those important sites for biodiversity.



Fig. 1. Beech forest as an example of natural Carpathian vegetation with low species diversity
Author: N. Kalinovych.



Fig. 2. An example of semi-natural Carpathian vegetation with high species diversity
Author: L. Tasenkevich.

In order to identify the status of semi-natural grass communities in the Ukrainian Carpathians and propose the sustainable management and protection, Ukrainian scientists participated in the Ukrainian Carpathians' Grasslands Inventory Project 2008-2010 (BBI-MATRA/2007/004). This project was funded by the Programme of International Nature Management of the Dutch Ministries of Agriculture, Nature and Food Quality and Foreign Affairs. The project partner in the

Netherlands was the Royal Dutch Society for Nature Conservation. This project was performed by scientists of several Ukrainian research institutions:

- State Natural History Museum, National Academy of Sciences of Ukraine;
- Institute of Ecology of the Carpathians, National Academy of Sciences of Ukraine;
- Lviv Ivan Franko National University;
- Uzhgorod National University;
- Chernivtsi National University;
- Uzhansky National Nature Park.

Grassland inventory started in 2008 with the following main objectives:

- The creation of a system of classification and identification of semi-natural and natural grasslands of the Ukrainian Carpathians according to the European standards;
- The selection of the most representative areas with domination of semi-natural and natural grasslands in the aspect of biodiversity conservation to be included into the mapping process;
- The development of a Carpathian grassland ecosystem database which could serve as a framework for actions aiming at conservation and proper management of the most valuable grasslands in the Ukrainian Carpathians as well as protection of landscape diversity and sustainable management of natural resources within a functional ECONET;
- The elaboration of recommendations on grassland management and sustainable use;
- Raising public awareness for protection and sustainable use of natural and semi-natural grasslands.

MATERIALS AND METHODS

The inventory of semi-natural grasslands have been carried out in 33 morphogenic meso-ecoregions of the Ukrainian Carpathians according to Kruhlov [2008]. In total, the investigating activities covered about 70% of the territory of the Ukrainian Carpathians. The non-investigated territories are located in regions where semi-natural grasslands are rare, arable fields or high-mountain lichen-covered stony waste-lands are dominating the landscape.

250,000 ha of grassland were identified for investigation by the analysis of satellite images in the frame of the project. As semi-natural and natural grassland were evaluated at 183,631 ha.

For identification of vegetation units, data from the Ukrainian Carpathians obtained with Braun-Blanquet method [Pawlowski & Walas 1948; Malynovsky & Krichfalushy 2002; Tasenkevich 2003; Solomakha et al. 2004] as well as the data from the adjacent Carpathian countries have been used [Coldea et all. 1997;

Matuszkiewicz 2001; Valachovič 2001; Janišová 2007; Kliment & Valachovič 2007; Jarolimek & Šibik 2008].

The GIS database has been build up, including information for phytosociological units, land management, land use, history of land use, specific threats like land abandonment.

RESULTS

48 phytosociological units on alliance level were distinguished among Carpathian semi-natural grasslands (Tab.1).

Tab. 1. Names and codes of alliances represented the semi-natural grasslands of the Ukrainian Carpathians

No	Names	Code	No	Names	Code
1	<i>Adenostylium alliariae</i>	ADA	25	<i>Filipendulion ulmariae</i>	FLU
2	<i>Agropyro-Rumicion crispi</i>	ARC	26	<i>Geranion sanguinei</i>	GSA
3	<i>Alopecurion pratensis</i>	ALP	27	<i>Juncion trifidi</i>	JTR
4	<i>Arrhenatherion elatioris</i>	ARE	28	<i>Loiseleurio-Vaccinion</i>	LOV
5	<i>Bidention</i>	BID	29	<i>Magnocaricion elatae</i>	MAC
6	<i>Calamagrostion arundinaceae</i>	CAA	30	<i>Molinion caeruleae</i>	MOC
7	<i>Calamagrostion villosae</i>	CAL	31	<i>Nardion</i>	NAR
8	<i>Calluno-Genistion</i>	CGE	32	<i>Nardo-Agrostion</i>	NAA
9	<i>Calthion palustris</i>	CTP	33	<i>Nardo-Caricion rigidae</i>	CRI
10	<i>Cardamino-Montion</i>	CMO	34	<i>Oxycocco-Empetrium hermaphroditii</i>	OXE
11	<i>Carici rigidae-Nardetum</i>	CRN	35	<i>Phragmition</i>	PHR
12	<i>Caricion bicolori-atrofuscae</i>	CAB	36	<i>Pohlio-Callunion</i>	PHC
13	<i>Caricion curvulae</i>	CAC	37	<i>Polygonion avicularis</i>	POA
14	<i>Caricion davalliana</i>	CAD	38	<i>Polygono-Trisetion</i>	PTR
15	<i>Caricion fuscae (=Caricion nigrae)</i>	CAF, CAN	39	<i>Potentillo-Nardion</i>	PTN
16	<i>Cirsio-Brachypodion pinnati</i>	CBR	40	<i>Pruno-Rubinion fruticosi</i>	PRF
17	<i>Convolvulo-Agropyron repens</i>	CAR	41	<i>Rhododendro-Vaccinion</i>	RHV
18	<i>Cratoneurion commutati</i>	CRC	42	<i>Rhynchosporion albae</i>	RHA
19	<i>Cynosurion cristati</i>	CYN	43	<i>Rumicion alpini</i>	RUA
20	<i>Deschampsion cespitosae</i>	DES	44	<i>Salicion herbaceae</i>	SLH
21	<i>Dryopterido-Athyriion</i>	DRA	45	<i>Sphagnion magellanici</i>	SPM
22	<i>Epilobion angustifolii</i>	EPA	46	<i>Trifolion medi</i>	TRM
23	<i>Festucion pictae</i>	FEP	47	<i>Vaccinion</i>	VAC
24	<i>Festuco saxatilis-Seslerion bielzii</i>	FSS	48	<i>Violion caninae</i>	VIC

Source: Own data.

Prevailing areas of researched lands are covered with phytocoenoses belonging to *Arrhenatherion elatioris* and *Cynosurion cristati* (Fig. 3).

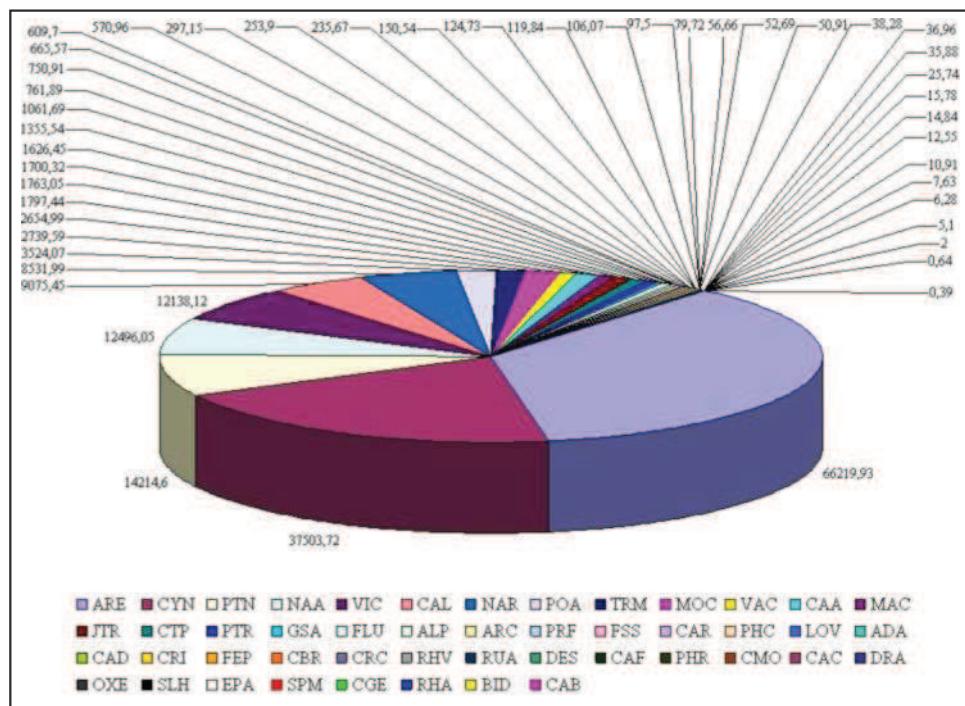


Fig. 3. Distribution of alliances according to the study area

Source: Own data.

The distinguished units were divided in four categories of grassland habitat types in accordance with the moisture and altitude gradient: dry, mesophilous, high-mountain and wet grasslands. Most common were mesophilous (76.6%) and high-mountain grasslands (13.5%). The wet and dry grasslands were present on the study area in a small proportion: 5.9% and 2.2% correspondingly (Fig. 4).

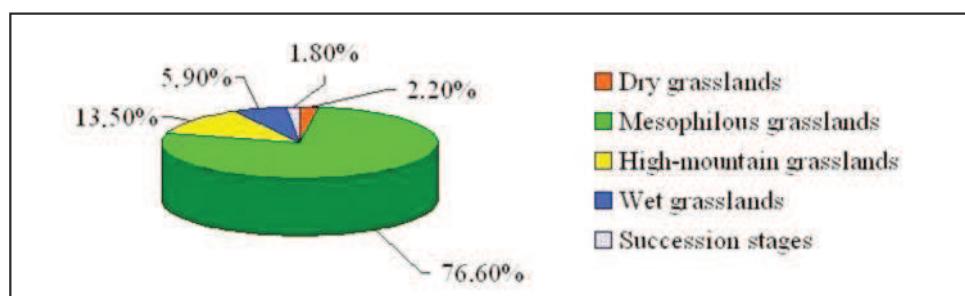


Fig. 4. Grassland habitat types according to area

Source: Own data.

DESCRIPTION OF GRASSLAND HABITAT TYPES IN FOREST BELT

DRY GRASSLANDS

Submontane xero-mesophile Brachypodium grasslands

Semi-natural dry grasslands

Indicative species: *Achillea millefolium*, *Alchemilla monticola*, *Anthyllis vulneraria*, *Avenula pubescens*, *Brachypodium pinnatum*, *Briza media*, *Carex flacca*, *Clinopodium vulgare*, *Dianthus carthusianorum*, *Euphrasia rostkoviana*, *Festuca ovina*, *Fragaria vesca*, *Leontodon hispidus*, *Leucanthemum ircutianum*, *Linum catharticum*, *Lotus corniculatus*, *Melampyrum nemorosum*, *Origanum vulgare*, *Pimpinella saxifraga*, *Plantago media*, *Potentilla inclinata*, *Ranunculus polyanthemos*, *Thymus pulegioides*, *Tragopogon orientalis*, *Trifolium alpestre*, *T. montanum*, *Viola riviniana*

Syntaxonomical classification: Cl. FESTUCO-BROMETEA Br.-Bl. et R.Tx.1943, Ord. Festucetalia valesiacae Br.-Bl. et R.Tx.1943, All. *Cirsio-Brachypodion pinnati* Hadač et Klika 1944

Association belonging: *Origano-Brachypodietum* Medw.-Korn. et Kornaś 1963

NATURA 2000: 6210 – Semi-natural dry grasslands

Average altitude: 442.3 m

Range of altitudes: 272-751 m

Average slope: 16.7°

Geological substrate: 80% – calcium rich flysh, 5% – polygenetic sediments, 1% – other types, 14% – no data

Average cover of woods: 16%

Management: 8.3% grazing; 91.7 % mowing

Distribution throughout the area: Rare in the western part of the area in sub-montane and lower part of montane belts. Found on 12 sites.

Area: Total area – 79.72 ha (0.04% of the total mapped area).

Xero-thermophile fringes

Semi-natural thermophile communities on the fringes of leafy forests

Indicative species: *Asperula cynanchica*, *Betonica officinalis*, *Brachypodium pinnatum*, *Briza media*, *Clinopodium vulgare*, *Elytrigia intermedia*, *Fragaria viridis*, *Galium album*, *Geranium sanguineum*, *Hypericum perforatum*, *Lychnis coronaria*, *Origanum vulgare*, *Peucedanum oreoselinum*, *Pimpinella saxifraga*, *Sanguisorba minor*, *Stachys recta*, *Trifolium alpestre*, *T. montanum*, *Vicia tenuifolia*, *Vincetoxicum hirundinaria*, *Viola hirta*

Syntaxonomical classification: Cl. TRIFOLIO-GERANIETEA SANGUINEI Th. Müll. 1962, Ord. Origanetalia Th. Müll. 1962, All. *Geranion sanguinei* R.Tx. 1961; All. *Trifolion medi* Th.Müll. 1962, All. *Pruno-Rubion fruticosi* R.Tx.1952 corr. Doing 1962

NATURA 2000: Partly 6210 – Semi-natural dry grasslands and scrubland facies on calcareous substrates

Average altitude: *Geranion sanguinei* – 280 m, *Trifolion medii* – 394 m
Range of altitudes: *Geranion sanguinei* – 152-664 m, *Trifolion medii* – 133-764 m
Average slope: *Geranion sanguinei* – 26°, *Trifolion medii* – 19°
Geological substrate: 60% – volcanic rocks, 20% – calcium rich flysh, 5 % polygenetic sediments, 1% – other types, 14% – no data
Average cover of woods: 30%
Management: 10% grazing; 80.5 % mowing, 5% unmanaged, 9.5% – no data
Distribution throughout the area: in the warmest parts of mountain foothills.
Geranion sanguinei found on 51 sites, *Trifolion medii* – on 159 sites, forming mosaic-like vegetation with scrub *Pruno-Rubion fruticosi*
Area: Total area – 4 072.44 ha (2.27 % of the total mapped area).

Submontane disturbed pastures

Indicative species: *Agrostis capillaris*, *Antennaria dioica*, *Calluna vulgaris*, *Carlina vulgaris*, *Centaurea jacea*, *Cuscuta epithymum*, *Dantonia decumbens*, *Diphasiastrum tristachium*, *Festuca ovina*, *Genista pilosa*, *G. germanica*, *G. tinctoria*, *Hieracium pilosella*, *Luzula campestris*, *Lycopodium clavatum*, *Ononis arvensis*, *Plantago lanceolata*, *Pteridium aquilinum*, *Rumex acetosella*, *Sarothamnus scoparius*, *Scleranthus perennis*, *Vaccinium myrtillus*, *Pohlia nutans*, *Ptilidium ciliare*, *Cladonia sp.*

Syntaxonomical classification: CL. NARDO-CALLUNETEA Preising. 1949, Ord. Calluno-Ulicetalia (Quant. 1935) R.Tx. 1937, All. *Calluno-Genistion* Duving. 1934, All. *Pohlio-Callunion* Shimwell. 1973 em. Brzeg 1981

Association belonging: *Calluno-Genistetum* R.Tx. 1937, *Sieblingio-Agrostietum* Brzeg 1981

NATURA 2000: Partly 4030 – European dry heaths

Average altitude: 402.5 m

Range of altitudes: 171-693 m

Average slope: 19°

Geological substrate: 50% – volcanic rocks, 25% – flysh, 35% – no data

Average cover of woods: 30%

Management: 90% grazing; 10% unmanaged

Distribution throughout the area: In the warmest parts of mountain foothills near settlements

Area: Total area – 240.77 ha (0.13 % of the total mapped area).

MESOPHILOUS GRASSLANDS

Mesophile grasslands with *Arrhenatherum elatius* in forest belt

Semi-natural fertile meadows communities

Indicative species: *Agrostis gigantea*, *A. capillaris*, *Anthyllis vulneraria*, *Achillea millefolium*, *Arrhenatherum elatius*, *Avenula pubescens*, *Bellis perennis*, *Bromus*

hordaceus, Campanula patula, Campanula serratula, Centaurea jacea, Cirsium arvense, Crepis biennis, Crucifera laevipes, Cynosurus cristatus, Dactylis glomerata, Daucus carota, Elytrigia repens, Festuca pratensis, F. rubra, Galium mollugo, G. verum, Geranium pratense, Hieracium caespitosa, Knautia arvensis, Leontodon hispidus, Leucanthemum vulgare, Lolium perenne, Lotus corniculatus, Pastinaca sativa, Phleum pratense, Plantago lanceolata, Poa pratensis, Prunella vulgaris, Ranunculus acris, Rhinanthus minor, Rumex acetosa, R. thyrsiflorus, Taraxacum officinale, Trifolium dubium, T. medium, T. pratense, T. repens, Veronica chamaedrys, Vicia cracca

Syntaxonomical classification: CL. MOLINIO-ARRHENATHERETEA R.Tx. 1937, Ord. Arrhenatheretalia elatioris Pawł. 1928, All. *Arrhenatherion elatioris* Br.-Bl. ex Scherr. 1925

Association belonging: *Poa pratensis-Festuca rubra* Fijałk. 1962, *Pastinaco-Arrhenatheretum* Passarge 1964, *Arrhenatheretum elatioris* Br.-Bl. ex Scherr. 1925, *Campanulo serratae-Agrostietum capillaris* Denisiuk et Korzeniak 1999, *Gladiolo-Agrostietum capillaris* (Br.-Bl. 1930) Pawł. et Wal. 1949, *Anthyllidi-Trifolietum montani* Pawł. 1971, *Anthoxantho odorati-Agrostietum tenuis* Sillinger 1933

NATURA 2000: Partly 6510 – Lowland hay meadows

Average altitude: 610 m

Range of altitudes: 90-1,500 m

Average slope: 16°

Geological substrate: 85% – flysh, 8% – volcanic rocks, 5% – calcareous rocks, 2% – no data

Average cover of woods: 4%

Management: 58% mowing, 35% – mowing/grazing, 6% – grazing, 0.4% – no management, 0,6% – no data

Distribution throughout the area: Prevailing throughout the whole territory. Found on 1750 sites (66 219.93 ha, 36.06%)

Area: Total area – 66 219.93 ha; (36.1 % of the total mapped area).

Mountain mesophile meadows

Indicative species: *Agrostis capillaris, Alchemilla monticola, Anthoxanthum odoratum, Astrantia maior, Campanula glomerata, Cardaminopsis halleri, Centaurea phrygia, C. carpatica, Crepis mollis, Dactylis glomerata, Geranium phaeum, Heracleum sphondylium, Hypericum maculatum, Lychnis flos-cuculi, Phleum hirsutum, Phyteuma spicatum, Polygonum bistorta, Primula elatior, Rumex alpestris, Scorzonera rosea, Trifolium pratense, Trisetum flavescens, Trollius europaeus*

Syntaxonomical classification: CL. MOLINIO-ARRHENATHERETEA R. Tx. 1937, Ord. Arrhenatheretalia elatioris Pawł. 1928, All. *Polygono-Trisetion* Br.-Bl. et R. Tx. ex. Marshall 1947

Association belonging: *Astrantio-Trisetetum* Knapp 1952, *Crepido mollis-Agrostietum capillaris* Ružičková 2004
NATURA 2000: Partly 6520 – Mountain meadows
Average altitude: 919 m
Range of altitudes: 718-1,424 m
Average slope: 16°
Geological substrate: 90% – flysh, 10% – no data.
Average cover of woods: 15%
Management: 54% – mowing, 44% – mowing-grazing, 2% – no management
Distribution throughout the area: Hay meadows in upper part of forest belt in places with long-lasting snow cover. Found on 154 sites.
Area: Total area – 1 061. 69 ha (0.58 % of the total mapped area).

Mesophile grasslands with *Cynosurus cristatus* in forest belt

Hill-mountain mesophile pastures

Indicative species: *Agrostis capillaris*, *Bellis perennis*, *Carum carvi*, *Cynosurus cristatus*, *Festuca pratensis*, *F. rubra*, *Lolium perenne*, *Leontodon autumnalis*, *Lotus corniculatus*, *Phleum pratense*, *Trifolium repens*, *Linum catharticum*, *Prunella vulgaris*, *Hypochaeris radicata*, *Potentilla erecta*, *Primula veris*, *Thymus pulegioides*, *Rhinanthus minor*

Syntaxonomical classification: CL. MOLINIO-ARRHENATHERETEA R. Tx. 1937, Ord. Arrhenatheretalia elatioris Pawł. 1928, All. *Cynosurion* R. Tx. 1943
Association belonging: *Lolio-Cynosuretum* R. Tx. 1937, *Festuco-Cynosuretum* Büker 1941, *Trifolio-Lolietum* Krippel 1967, *Festuco-Agrostetum capillaris* Horv. 1951

NATURA 2000: 6520 – Hill-mountain meadows
Average altitude: 604 m
Range of altitudes: 138-1,276 m
Average slope: 16°
Geological substrate: 85% – flysh, 15% – no data.
Average cover of woods: 2%
Management: 76% – grazing, 17% – mowing/grazing, 7% – no management
Distribution throughout the area: Very frequently throughout the area. Found on 817 sites
Area: Total area – 37 503. 72 ha (20.4 % of the total mapped area).

Mountain mesophile oligotrophic pastures

Indicative species: *Achillea millefolium*, *Agrostis capillaris*, *Alchemilla vulgaris*, *Anemone nemorosa*, *Anthoxanthum odoratum*, *Arnica montana*, *Briza media*, *Deschampsia cespitosa*, *Antennaria dioica*, *Alchemilla xanthochlora*, *Calluna vulgaris*, *Carex pallescens*, *Coeloglossum viride*, *Cruciata glabra*, *Danthonia*

decumbens, *Dianthus deltoides*, *Euphrasia rostkoviana*, *Festuca ovina*, *F. rubra*, *F. tenuifolia*, *Gymnadenia conopsea*, *Hieracium pilosella*, *Hypochoeris maculata*, *Leontodon hispidus* subsp. *danubialis*, *Luzula campestris*, *Nardus stricta*, *Omalotheca sylvatica*, *Potentilla erecta*, *Polygala vulgaris*, *Stellaria graminea*, *Viola canina*, *Vaccinium myrtillus*, *V. vitis-idaea*

Syntaxonomical classification: CL. NARDO-CALLUNETEA Preising. 1949, Ord. Nardetalia Oberd. ex Preising. 1949, All. *Violion caninae* Schwickerath 1944, All. *Nardo-Agrostion tenuis* Sillinger 1933

Association belonging: *Calluno-Nardetum strictae* Hrync. 1959, *Polygallo-Nardetum* Prsg. 1953, *Gymnadenio-Nardetum* Moravec 1965, *Soldanello montanae-Nardetum* (Sillinger 1933) Šomšák 1971, *Carici leporinae-Agrostietum tenuis* Hadač et Sýkora 1971, *Carici rigidiae-Nardetum* (Zlatník 1928) Jenik 1961, *Helictotricho planiculmes-Nardetum strictae* Grebenščíkova et al. ex Šomšák 1971, *Hieracio vulgati-Nardetum* Kornaš 1955 n.n. em. Balcerk. 1984, *Homogyno alpinae-Nardetum* Mraz 1957

NATURA 2000: Partly 6230* – Acidophilous mountain *Nardus* pastures; Species-rich *Nardus* grasslands, on siliceous substrates in mountain and submountain areas in continental Europe

Average altitude: 679 m (*Violion caninae*), 1,103° (*Nardo-Agrostion tenuis*)

Range of altitudes: 179-1,357 m (*Violion caninae*), 467-1,557 m (*Nardo-Agrostion tenuis*)

Average slope: 16°

Geological substrate: 90% – flysh, 10% – no data.

Average cover of woods: 10%

Management: 61% – mowing/grazing, 37% – grazing, 2% – no management (*Violion caninae*), 49% – mowing/grazing, 36% – grazing, 15% – no management

Distribution throughout the area: Pastures in forest belt and lower altitudes of subalpine belt

Area: Total area – 24 634.17 ha (13.4 % of the total mapped area).

Mountain and sub-alpine tall-grass meadows

Indicative species: *Achillea stricta*, *Allium victorialis*, *Calamagrostis arundinaceae*, *C. villosa*, *Deschampsia cespitosa*, *Campanula abietina*, *Clinopodium vulgare*, *Crepis conyzifolia*, *Epilobium angustifolium*, *Laserpitium krapfii*, *Poa chaixii*, *Juncus effusus*, *Tanacetum corymbosum* subsp. *clusii*, *T. vulgare*, *Veratrum lobelianum*

Syntaxonomical classification: CL. MULGEDIO-ACONITETEA Hadač et Klika in Klika 1948, Ord. *Calamagrostietalia villosae* Pawł. et all. 1948, All. *Calamagrostion villosae* Luqu. 1926, All. *Calamagrostion arundinaceae* (Luqu. 1923) Jenik 1961

Association belonging: *Calamagrostietum villosae* Pawł., Sokoł. et Wall. 1928,

Poo-Veratretum lobeliani Kornaś (1955 n.n.) 1967, *Poo-Deschampsietum* Pawł. et Wal. 1949, *Hyperico alpigeni-Calamagrostietum villosae* Pawł. et Wał. 1949, *Phleo alpini-Deschampsietum cespitosae* (Krajina 1933) Coldea 1983, *Vaccinio myrtilli-Calamagrostietum villosae* Sillinger 1933, *Achilleo strictae-Calamagrostietum arundinaceae* Hadač et al. 1988

NATURA 2000: 6430 – Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

Average altitude: 1,242 m

Range of altitudes: 478-1,915 m

Average slope: 20°

Geological substrate: 85% flysh, 5% – crystalline rocks and schist, 10% – no data

Average cover of woods: 5%

Management: 10% – mowing/grazing, 42.5% – grazing, 10% mowing, 28.5% – no management, 10% – no data

Distribution throughout the area: Natural grasslands in sub-alpine belt of highest ridges, succession on abandoned sub-alpine *Nardus* pastures

Area: Total area – 10 838.5 ha (5.9 % of the total mapped area).

Mountain and sub-alpine tall-herb grasslands

Indicative species: *Achillea lingulata*, *Aconitum firmum*, *A. moldavicum* subsp. *moldavicum*, *A. moldavicum* subsp. *hosteanum*, *A. lasiocarpum*, *Adenostyles alliaria*, *Astrantia major*, *Athyrium distentifolium*, *A. filix-femina*, *Cirsium waldsteinii*, *Clinopodium vulgare*, *Centaurea maramorisiensis*, *Dryopteris filix-mas*, *D. dilatata*, *Doronicum austriacum*, *Epilobium angustifolium*, *E. montanum*, *Geranium sylvaticum*, *Knautia dipsacifolia*, *Laserpitium latifolium*, *Myosotis alpestris*, *Mulgedium alpinum*, *Pedicularis verticillata*, *Petasites kablikianus*, *Poa chaixii*, *Ranunculus platanifolius*, *Rumex alpinus*, *Traunsteinera globosa*, *Viola biflora*

Syntaxonomical classification: CL. MULGEDIO-ACONITETEA Hadač et Klika in Klika 1948, Ord. Calamagrostietalia villosae Pawł. et all. 1948, Ord. Rumicetalia alpini Mucina in Karner et Mucina 1993, Ord. Adenostyletalia BR.-BL. 1931, All. *Rumicion alpini* (Rübel 1933) Klika et Hadač 1944, All. *Adenostylion alliariae* Br.-Bl. 1925, All. *Dryopteridi-Athyriion distentifolii* Holub in Holub et al. ex Sýkora et Štursa 1973

Association belonging: *Rumicetum alpini* Beger 1922, *Adenostyletum alliariae* Pawł., Sokol. et Wall. 1928, *Athyrietum distentifolii* Hadač 1955 em. W.Matt. 1960, *Arunco-Doronicetum austriaci* Kornaś (1955 n.n.) 1967, *Ranunculo platanifolii-Adenostyletum alliariae* (Krajina 1933) Dubravcová in Mucina et Maglocký 1985, *Chaerophyllo-Cicerbietum alpinae* Sýkora et Hadač

NATURA 2000: 6430 – Hygrophilous tall herb fringe communities of plains and of the montane to alpine belts

Average altitude: 1,223 m
Range of altitudes: 480-1,805 m
Average slope: 16°
Geological substrate: 85% – flysh, 5 – crystalline rocks and schist, 10% – no data
Average cover of woods: 5%
Management: 33% – grazing, 50% – no management, 27% – no data
Distribution throughout the area: On highest ridges of the mountains
Area: Total area – 10 914.64 ha (5.94 % of the total mapped area).

HIGH-MOUNTAIN GRASSLANDS

Subalpine oligotrophic pastures

Indicative species: *Avenula versicolor*, *Festuca nigrescens*, *F. airoides*, *Deschampsia flexuosa*, *Poa media*, *Potentilla aurea*, *Campanula abietina*, *C. serrata*, *C. polymorpha*, *Scorzonera rosea*, *Gentiana acaulis*, *Geum montanum*, *Hieracium aurantiacum*, *Hypochaeris uniflora*, *Ligusticum mutellina*, *Leucorchis albida*, *Thymus alpestris*, *Veronica officinalis*, *Viola declinata*

Syntaxonomical classification: CL. NARDO-CALLUNETEA Preising. 1949

Ord. Nardetalia Oberd. ex Preising. 1949, All. *Potentillo ternatae-Nardion* Simon 1957; All. *Nardion* Br.-Bl. 1926 em. Oberd. 1959

Associations belonging: *Violo declinatae-Nardetum* Simon 1966, *Scorzonero-Festucetum nigricantis* Coldea 1987; *Scorzonero roseae-Festucetum nigricantis* Coldea 1987, *Festucetum rubrae* Pușcaru et all. 1956, *Hieracio (alpini)-Nardetum* Szafer et all. 1923 em. Balcerk. 1984

NATURA 2000: 6230* – Acidophilous subalpine *Nardus* pastures;

Average altitude: 1,263 m (*Nardion*), 1,528 m (*Potentillo-Nardion*)

Range of altitudes: 761-1,803 m (*Nardion*), 1,200-1,856 m (*Potentillo-Nardion*)

Average slope: 20°

Geological substrate: 90% – flysh, 10% – no data

Average cover of woods: 2%

Management: 85% – grazing, 15% – unmanaged

Distribution throughout the area: The most common pasture communities in polonynas

Area: Total area – 22 746. 59 ha (12.4 % of the total mapped area).

WET GRASSLANDS

Semi-natural tall-herb humid meadows

Indicative species: *Betonica officinalis*, *Briza media*, *Carex pallescens*, *C. panicea*, *C. tomentosa*, *Cirsium palustre*, *Colchicum autumnale*, *Crepis paludosa*, *Dactylis glomerata*, *Deschampsia cespitosa*, *Dianthus deltoides*, *Epipactis palustris*, *Eriophorum latifolium*, *E. angustifolium*, *Festuca arundinacea*, *F. pratensis*, *F. rubra*, *Galium uliginosum*, *Gentiana pneumonanthe*, *Juncus conglomeratus*,

Luzula multiflora, *Lychnis flos-cuculi*, *Molinia coerulea*, *Potentilla erecta*, *Sanquisorba officinalis*, *Selinum carvifolia*, *Silaum silaus*, *Succisa pratensis*, *Viola palustris*.

Syntaxonomical classification: CL. MOLINIO-ARRHENATHERETEA R. Tx. 1937, Ord. Molinietalia coeruleae W.Koch 1926, Ord. Molinietalia coeruleae W.Koch 1926, All. *Molinion coeruleae* W.Koch 1926

Associations belonging: *Molinietum caeruleae* W.Koch 1926, *Junco-Molinietum* Preising 1951

NATURA 2000: 6410 – *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion coeruleae*)

Average altitude: 635 m

Range of altitudes: 219-1,373 m

Average slope: 11°

Geological substrate: 90% – alluvial clay, 10% – no data

Average cover of woods: 5%;

Management: 80% – mowing, 20% – grazing

Distribution throughout the area: Sparsely distributed on organogenic and mineral rich intermittently wet soils in the submontane and montane belt

Area: Total area – 2 654.99 ha (1.45 % of the total mapped area).

Submontane alluvial water-meadows

Indicative species: *Alopecurus pratensis*, *Agrostis stolonifera*, *Cardamine pratensis*, *Deschampsia cespitosa*, *Elytrigia repens*, *Festuca pratensis*, *F. rubra*, *Glechoma hederacea*, *Lathyrus pratensis*, *Lychnis flos-cucula*, *Lysimachia nummularia*, *Poa pratensis*, *P. trivialis*, *Potentilla reptans*, *Ranunculus acris*, *R. repens*, *Symphytum officinale*, *Taraxacum sp.*, *Trifolium hybridum*.

Syntaxonomical classification: CL. MOLINIO-ARRHENATHERETEA R. Tx. 1937, Ord. Molinietalia coeruleae W.Koch 1926, All. *Alopecurion pratensis* Pass.1964

Associations belonging: *Alopecuretum pratensis* (Regel 1925) Steffen 1931

NATURA 2000: 6510 Lowland hay meadows (*Alopecurus pratensis*,

Sanguisorba officinalis)

Average altitude: 318 m

Range of altitudes: 138-695 m

Average slope: 18°

Geological substrate: 90% – alluvial clay, 10% no data

Average cover of woods: 0%;

Management: 54% – mowing, 30% – unmanaged, 16% – no data

Distribution throughout the area: Formerly very often on the river terraces. Nowdays area of these high-productive meadows is reduced mainly due to ploughing.

Area: Total area – 665.57 ha (0.36 % of the total mapped area).

Flood-land pastures

Indicative species: *Agrostis stolonifera*, *Alopecurus aequalis*, *A. geniculatus*, *Glechoma hederacea*, *Juncus effusus*, *J. inflexus*, *Lolium perenne*, *Lycopus europaeus*, *Mentha longifolia*, *Poa trivialis*, *Potentilla anserina*, *Ranunculus repens*, *R. sardous*, *Rumex crispus*

Syntaxonomical classification: CL. MOLINIO-ARRHENATHERETEA R. Tx. 1937, Ord. Plantaginetalia majoris R.Tx. (1943) 1950, Ord. Potentillo-Polygonetalia R. Tx. 1947, Ord. Trifolio fragiferae-Agrostietalia stoloniferae R.Tx. 1970, All. *Polygonion avicularis* Br.-Bl. 1931 ex Aich. 1933, All. *Potentillion anserinae* R. Tx. 1937, All. *Agropyro-Rumicion crispi* Nordh. 1940 em. R.Tx. 1950, All. *Bidention tripartiti* Nordhagen 1940 em. R.Tx. in Poli et J.Tx. 1960

Associations belonging: *Lolio-Polygonetum arenastri* Br.-Bl. 1930 em. Lohm. 1975, *Festuco pratensis-Plantaginetum* Balcerk. et Pawlak 2000, *Juncetum tenuis* (Diem., Siss. et Westh. 1940) Schwick. 1944 em. R.Tx. 1950, *Junco-Menthetum longifoliae* Lohy. 1953, *Epilobio-Juncetum effusi* Oberd. 1957, *Rorippo austriacae-Agropyretum repantis* R. Tx. 1950, *Rumici crispi-Agrostetum stoloniferae* Moor 1958

Average altitude: 355 m

Range of altitudes: 132-814 m

Average slope: 14°

Geological substrate: 80% – alluvial clay, 20% no data

Average cover of woods: 0%;

Management: 28% – mowing, 43% – grazing, 29% – unmanaged

Distribution throughout the area: Overgrazed pastures on the river banks near the settlements

Area: Total area – 3 524.71 ha (266 polygons, 2 % of the total mapped area).

Hygrophilous tall-herb grasslands

Indicative species: *Aegopodium podagraria*, *Angelica sylvestris*, *Caltha palustris*, *Carex nigra*, *C. panicea*, *Chaerophyllum hirsutum*, *Cirsium heterophyllum*, *C. oleraceum*, *C. palustre*, *C. rivulare*, *Crepis paludosa*, *Dactylorhiza majalis*, *Deschampsia cespitosa*, *Equisetum palustre*, *Festuca rubra*, *Filipendula ulmaria*, *Geum rivale*, *Holcus lanatus*, *Juncus acutiflorus*, *J. conglomeratus*, *J. filiformis*, *Lysimachia vulgaris*, *Lythrum salicaria*, *Myosotis scorpioides*, *Ranunculus repens*, *Scirpus sylvaticus*, *Succisa pratensis*

Syntaxonomical classification: CL. MOLINIO-ARRHENATHERETEA R. Tx. 1937, Ord. MOLINIETALIA COERULEAE W.Koch 1926, All. *Calthion palustris* R.Tx. 1936 em. Oberd. 1957, All. *Filipendulion ulmariae* Segal 1966

Associations belonging: *Scirpetum sylvatici* Ralski 1931, *Cirsietum rivularis* Nowinski 1927, *Angelico-Cirsietum oleracei* R.Tx. 1936 em. Oberd. 1957, *Epilobio-Juncetum effusi* Oberd. 1957, *Polygono bistortae-Trollietum europaei*

(Hundt 1964) Bal.-Tul. 1981, *Deschampsietum cespitosae* Horvatič 1930, *Epilobio-Juncetum effusi* Oberd. 1957, *Junco-Cynosuretum* Sounez 1957, *Lysimachio vulgaris-Filipenduletosum* Bal.-Tul. 1978, *Lythro-Filipenduletum ulmariae* Hadač et all. 1997, *Filipendulo ulmariae-Menthetum longifoliae* Zlinska 1989

NATURA 2000: 6430 – Hygrophilous tall herb communities of plains and of the montane to alpine levels

Average altitude: 647 m

Range of altitudes: 292-1,084 m

Average slope: 9°

Geological substrate: 90% – clay alluvial sediments, 10% – no data

Average cover of woods: 0%

Management: 61% – mowing, 36% – grazing, 3% – no data

Distribution throughout the area: In small patches on the river and stream banks mainly in submontane and montane belts

Area: Total area – 1 355.54 ha (0.74 % of the total mapped area).

Tall sedge and mud grasslands

Indicative species: *Calamagrostis canescens*, *Calliergonella cuspidata*, *Caltha palustris*, *Carex acutiformis*, *C. appropinquata*, *C. flava*, *C. gracilis*, *C. lasiocarpa*, *C. nigra*, *C. paniculata*, *C. riparia*, *C. rostrata*, *C. vesicaria*, *Epilobium palustre*, *Equisetum fluviatile*, *Eriophorum angustifolium*, *Lychnis flos-cuculi*, *Phragmites australis*, *Poa palustris*, *P. trivialis*, *Stachys palustris*, *Typha latifolia*

Syntaxonomical classification: Cl. PHRAGMITETEA AUSTRALIS R.Tx. et Preisig 1942, Ord. Magnocaricetalia Pignatti 1953 All. *Magnocaricion elatae* Koch 1926, All. *Sparganio-Glycerion fluitantis* Br.-Bl. et Siss. in Boer 1942, Ord. PHRAGMITETALIA Koch 1926, All. *Phragmition* Koch 1926

Associations belonging: *Caricetum acutiformis* Egger 1933, *Caricetum paniculatae* Wangerin 1916, *Caricetum ripariae* Soó 1928, *Caricetum rostratae* Rübel 1912, *Iridetum pseudacori* Egger 1933, *Calamagrostietum canescens* Simon 1950, *Sparganio-Glycerietum fluitantis* Br.-Bl. 1925, *Glycerietum plicatae* (Kulcz. 1928) Oberd. 1954, *Phragmitetum australis* (Gams 1927) Schmale 1939, *Typhetum latifoliae* Soó 1927

NATURA 2000: 6430 – Hygrophilous tall herb communities of plains and of the montane to alpine levels

Average altitude: 966.5 m

Range of altitudes: 432-1,814 m

Average slope: 10,5°

Geological substrate: 70% – clay, 30 – peat sediments

Average cover of woods: 0%

Management: 33% – mowing, 17% – grazing, 50% – unmanaged

Distribution throughout the area: In small patches in rivers, stream and glacier valleys from submontane to subalpine belts.

Area: Total area – 1 736.2 ha (0.95 % of the total mapped area).

Base-rich fen meadows

Indicative species: *Blysmus compressus*, *Carex brizoides*, *C. davalliana*, *C. echinata*, *C. flava*, *C. lepidocarpa*, *C. panicea*, *C. nigra*, *Cirsium rivulare*, *Crepis paludosa*, *Dactylorhiza incarnata*, *D. latifolia*, *D. maculata*, *Deschampsia cespitosa*, *Epilobium palustre*, *Epipactis palustris*, *Eriophorum angustifolium*, *E. lalifolium*, *Gymnadenia densiflora*, *Menyanthes trifoliata*, *Oxycoccus palustris*, *Parnassia palustris*, *Ranunculus flammula*, *Triglochin palustre*, *Valeriana simplicifolia*, *Viola palustris*, *Campylium stellatum*, *Calliergon cuspidatum*, *Climaciumpendroides*, *Cratoneurum filicinum*

Syntaxonomical classification: CL. SCHEUCHZERIO-CARICETEA NIGRAE (Nordh. 1937) R.Tx. 1937, Ord. Scheuchzerietalia palustris Nordh. 1937, All. *Caricion davallianae* Klika 1934, All. *Caricion fuscae* W.Koch 1926 em. Klika 1934

Associations belonging: *Valeriano-Caricetum flavae* Pawł. (1949 n.n.) 1960, *Caricetum nigrae (subalpinum)* Br.-Bl. 1915

NATURA 2000: 7230 – Alkaline fens

7140 – Transition mires and quaking bogs (partly)

Average altitude: 696 m

Range of altitudes: 400-1,444 m

Average slope: 11°

Geological substrate: 70% – flysh, 30 – no data

Average cover of woods: 0%

Management: 45% – mowing, 48% – grazing, 7% – unmanaged

Distribution throughout the area: Small patches of so called “hunging fens” scarcely distributed on mountain slopes with calcium-rich waters from submontane to subalpine belts.

Area: Total area – 1 772.39 ha (0.96 % of the total mapped area).

Grasslands in the Ukrainian Carpathians have been extensively used for centuries. Intensively they were managed on a small scale during the soviet period when large collective farms were specializing on cattle- and sheep-breeding. During the last two decades the life-stock radically dropped and area of abandoned hay-meadows and grazing areas increases steadily (Fig. 6).

Comparatively low percentage of unmanaged grasslands seen on diagram above is stipulated by the fact that grasslands on 40% already overgrown by trees and bushes have not been involved into the study.

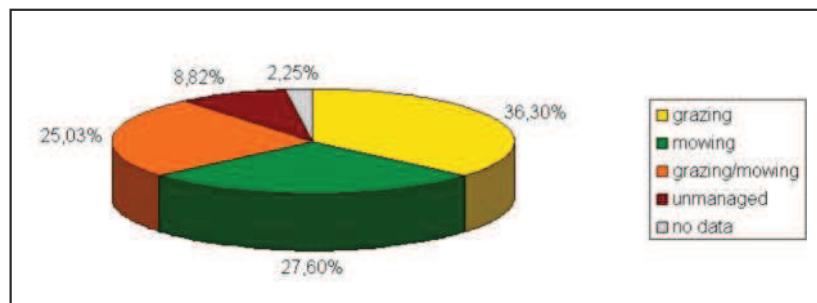


Fig. 5. Distribution of grasslands according to the type of management

Source: Own data.

Semi-natural grasslands usually need regular grazing and/or mowing, because the abandonment most often results in encroachment of shrubs or trees. The appropriate use of different management regimes does sustain diversity and conservation value of grasslands.



Fig. 6. Forest expansion on abandoned lands

Author: N. Kalinovych.



Fig. 7. *Juniperus communis* advancing on pasture
Author: L. Tasenkevich.

CONCLUSIONS

In summary, almost all the landscape changes that have occurred in the study areas were due to changing human influences. The abandonment of farming activities has clearly favored natural ecological succession and the degradation of the agricultural landscape. At the same time, the abandonment of farming leads to the disappearance of semi-natural grasslands and decreasing of biodiversity.

Unfortunately, Ukraine has not got any Agri-Environmental Schemes elaborated for implementation on the country scale. There is no special legal document regulating the conservation of habitats and species found in the grasslands.

The sustainable management of grasslands should be a top priority because they represent valuable habitats, contribute significantly to Ukraine's biodiversity: 210 threatened and endemic plant species of the Ukrainian Carpathians are components of grasslands.

Based on the outcome of this project the following conclusions have been drawn:

- The major part of the grasslands in the Ukrainian Carpathians can be classified as semi-natural;
- There have been revealed a number of grassland syntaxa unknown till now in the area;

- The total area of 250,000 ha was verified, 183,631 ha of semi-natural and natural grasslands were mapped;
- On average, 15% of the grasslands studied suffer from abandonment: overgrowing mainly with *Juniperus communis*, *Vaccinium myrtillus*, *Picea abies*, *Fagus sylvatica*, *Alnus incana* is in advance.

The following recommendations were developed at the final stage of this project:

- The key semi-natural grassland complexes should be included in the Emerald (Natura 2000) network;
- The process of abandonment of the grasslands should be addressed by restoration of these grasslands through mowing and grazing;
- The strategy for preservation of semi-natural grasslands needs to be elaborated not only on regional but on the state level.

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STRESZCZENIE

Pomimo globalnego trendu do zmniejszania obszarów krajobrazów naturalnych, w niektórych regionach, szczególnie w zachodniej części Ukrainy, możemy obserwować spontaniczne odnawianie się zbiorowisk leśnych na opuszczonej polach uprawnych, łąkach i pastwiskach. Gospodarowanie człowieka miało wpływ na Karpackie ekosystemy leśne w ciągu wielu stuleci. Koszenie doprowadziło do powstania półnaturalnych zbiorowisk trawiastych z różnorodnością gatunkową większą niż w otaczających ekosystemach leśnych. Półnaturalne zbiorowiska trawiaste są ośrodkami, w których skupia się wiele gatunków roślin oraz innych grup organizmów, prawnie objętych ochroną.

Zbiorowiska roślin zielnych w Karpatach Ukraińskich nie były przedmiotem systematycznych badań naukowych w ciągu ostatnich dziesięcioleci. Znajomość ich struktury, charakteru i skali przemian jest bardzo ogólnikowa. W Ukrainie jako całości i szczególnie w ukraińskiej części Karpat istnieje pilna potrzeba inwentaryzacji i mapowania zbiorowisk roślinnych według zasad przyjętych w sąsiadujących krajach karpackich. W ramach projektu BBI-MATRA/2007/004 zostały przeprowadzone podobne badania na około 70% obszaru Karpat Ukraińskich, wynikiem których jest stworzenie bazy danych, zawierającej m.in. zdjęcia fitosocjologiczne, informację o warunkach glebowych, o historii oraz współczesnym stanie użytkowania półnaturalnych zbiorowisk trawiastych. W ich składzie wyróżniono 48 jednostek w randze związku. Przeważająca część badanego obszaru obejmują fitocenozy należące do związków *Arrhenatherion elatioris* i *Cynosurion cristati*. Najczęściej są to łąki mezofilne (76,6%) i murawy wysokogórskie (13,5%). W ciągu ostatnich dwóch dziesięcioleci, obszary opuszczonych łąk i pastwisk zwiększały się. To powoduje zarastanie krzewami i lasem. W celu uniknięcia ingerencji lasu i obniżenia poziomu rozmaistości gatunkowej, niezbędne jest regularne koszenie lub wypas półnaturalnych zbiorowisk trawiastych.

SUMMARY

Despite the global trend towards decreasing of natural landscape areas, in some regions, particularly in the West of Ukraine, we can observe spontaneous recovery of forest communities in abandoned farmlands. Human practices have had an impact on Carpathian forest ecosystems for a long time. Centuries of mowing has led to the formation of semi-natural grass communities with species diversity higher than in the surrounding forest ecosystems. Many plant species and other groups of organisms under protection have their important habitats in semi-natural grasslands. The grasslands of the Ukrainian Carpathians have not been a matter of systematic scientific research over the last decades and our knowledge on their phytocoenotic structure, about the nature and scale of the changes are general and scarce. Ukraine as a whole and the Ukrainian Carpathians in particular need urgently an inventory and mapping of the grassland vegetations in accordance to the European standards. In order to identify the status of semi-natural grass communities in Ukrainian Carpathians and propose the sustainable management and protection, scientific project for Grasslands Inventory (BBI-MATRA/2007/004) has been performed in the Ukrainian Carpathians. The investigating activities covered about 70% of the territory of the Ukrainian Carpathians. The GIS database have been build up, including information for phytosociological units, land management, land use, history of land use, specific threats like land abandonment. 48 phytosociological units on alliance level were distinguished among Carpathian semi-natural grasslands. The prevailing areas of the researched lands are covered with phytocoenoses belonging to *Arrhenatherion elatioris* and *Cynosurion cristati*. Mesophilous (76.6%) and high-mountain grasslands (13.5%) are the most common. During the last two decades, the area of the abandoned hay-meadows and grazing areas has increased. Due to the abandonment most often it results in the encroachment of shrubs or trees as semi-natural grasslands need regular mowing or grazing. The appropriate use of different management regimes sustain diversity and conservation value of grasslands.