Observation de l'environnement de Montagne en Europe, Sciences de la Nature. Symposium international OM2 14-18 Octobre 1997, Borovetz, Bulgarie. p. 148-151.
Statistical Annual Reports. 2001.Sofia (in Bulgarian). National Statistic Institute, p. 360-374.
Stoyanov, D., 2001: Non-tree forest products (in Bulgarian). Sofia, Handbook of silviculture, Zemizdat, p. 360-374.
Stoyanova, N., 1989: The research of reproductive abilities of dendrolcoenosis in ecosystem *Piceto-Abietum* saniculosum. VEDA, Bratislava, Folia Dendrologica, *16*, p. 251-258.
Stoyanova, N., 1989: Ecological conditions and natural renovation in the economically affected coniferous stands (in Bulgarian). Sofia, Magazine of BAS, 5, p. 53-57.
Stoyanova, N., 1992: Ecological and typological investigation on low-mountain forest ecosystems of the natural range of *Fagus sylvatica* L. (in Bulgarian). Sofia, Comptes rendus de l'Academie bulgare des Sciences, BAS, *45*, 4, p. 93-95.
Stoyanova, N., 1992: Landscape peculiarity of the ecosystems of common beech (*Fagus sylvatica* L.) (in Bulgarian). Sofia, Comptes rendus de l'Academie bulgare des Sciences de Bulgarie, BAS, *45*, 4, p. 97-99.
Stoyanova, N., 1992: Bioecolcgical investigation of the low-mountain dendrocoenosis of beech's natural range (*Fagus sylvatica* L.). VEDA, Bratislava, Folia dendrologica, *19*, p. 89-95.
Stoyanova, N., 1994: Structure of the young growing plants and dynamic of renovation in forest ecosystems from the biosphere reserve "Parangalitza" (in Bulgarian). Sofia, BAS, Forest science, 3, p. 77-84.
Stoyanova, N., 1997: Bioecological investigations on the renovation floor in pine tree ecosystems from station "V. Serafimov" in South Rila Mountain (in Bulgarian). Sofia, BAS, Forest Science, 3-4, p. 40-46.
Stoyanova, N., 1998: Investigation on the renovation process in forest ecosystems from station "Govedarzi" in Rila Mountain (in Bulgarian). Sofia, Collection of science reports "70 years Institute of Forestry", 6-7-Oct., I, p. 182-186.
Stoyanova, N., 2001: Renovation in the forest of *Picea abies* (L.) K a r s t. in Rila Mountain (in Bulgarian). Sofia, Third Balkan Scientific Conference "Study, Conservation and Utilisation of Forest Resources", Proceeding, I, 2-6 Oct. 2001, p. 496-503.
Subev, L., Stanev, S., 1963: Climatic regions in Bulgaria and their climate (in Bulgarian). Sofia, Zemizdat, 183 pp.
Urukov, S., 2001: Tree plants (in Bulgarian). Sofia, Handbook of silviculture, Zemizdat, p. 31-1001.
Zahariev, B., Donov, V., Petrunov, K., Masarov, S., 1979: Forest vegetation regions in Bulgaria (in Bulgarian). Sofia, Zemizdat, 199 pp.

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Stoyanova N., Zhiyanski M.: **Ekologické podmienky, priestorová diferenciácia a biodiverzita lesov v Bulharsku.**

V práci predkladáme syntetický prehľad o lesných porastoch a špeciálnej vegetácii na území Bulharska. Údaje o rozšírení prirodzenej vegetácie v rôznom tepelno-klimatickom pásme opisujeme na základe podrobnej charakteristiky ekologických podmienok. Zistili sme, že naša krajina má tieto pásma: alpínske, subalpínske, vysokohorské, stredohorské, nízkohorské a zonálne predhorské pásmo. V prípade lesov rozlišujeme zónu *Pinus mugo*, zónu *Picea abies* a *Pinus peuce*, zónu *Fagus sylvatica* a ihličňanov, zónu druhov *Quercus*. Výškové lesné pásma sú tri, a to vysokohorské, stredohorské pásmo bukového a ihličnatého lesa, nižšie nížinno-hornaté a hornaté predhorské pásmo dubových lesov. Každý z nich má tri podpásma. V práci prezentujeme aktuálne informácie o rozšírení a prirodzenej obnove hlavných lesných typov v Bulharsku. Označené sú hlavné lesné stromy formujúce štruktúru prírodných lesných ekosystémov podľa nadmorskej výšky a pôdno-klimatických podmienok. V štruktúre prírodných lesov prevažujú druhy *Picea abies* (L.) K a r s t., *Pinus sylvestris* L., *Abies alba* M i l l., *Fagus sylvatica* L., *Carpinus betulus* L., *Quercus petraea* L i e b l., *Quercus cerris* L., *Quercus pubescens* W i l l d. a zriedkavo *Quercus robur* L., *Quercus coccifera* L., *Quercus hartwissiana* S t e v. od vysokých po nižšie položené časti krajiny.

EVALUATION OF GRASSLAND QUALITY

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Abstract

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This paper has a methodical character. Evaluation of grassland quality was verified over ten years in 1200 floristic analyses of grassland in the Western Carpathians. The quality of grassland can be understood on the base of floristic analysis. This analysis consists of the dominance (D) of individual species in floristic groups (in %):

1. Monocotyledoneae – grasses (Poaceae)
2. Monocotyledoneae – sedge and rush family (Cyperaceae + Juncaceae)
3. Monocotyledoneae – families Liliaceae, Orchidaceae and Iridaceae
4. Dicotyledoneae – leguminous plants (Fabaceae)
5. Dicotyledoneae – other families of dicotyledonous species
6. Pteridophyta – pterydophyte ferns (Aspidiaceae, Equisetaceae, Hypolepidaceae), and the rest constituted by Bryophyta (mosses) with a share of empty places, and their forage value (FV) in the grassland within the scale from -4 to 8 (Table 1), calculated by the formula:

$$E_{GQ} = \frac{\Sigma (D.FV)}{8}.$$

Evaluation of grassland quality (E_{GQ}) oscillates within the range from minus values (toxic), through deleterious, worthless, low values, lower values, valuable, high values to top values of grassland with maximum value of 100. It can serve for the research and practical survey of the quality of pasture and meadow grasslands. The advantage of the given evaluation in comparison with the other types is the wider scale of forage values, simplicity of calculation and practical use of 100 point scale. The evaluation of grassland can give a clue for the general or partial reconstruction, eventually revitalisation to increase forage value. There must be made a compromise between aesthetic and feeding value of grassland. As the high portion of aesthetic species has low feeding value, and does not meet the requirements for animal nutrition, it is necessary to revitalise the grasslands by the additional seeding of valuable or high valuable species, accordingly to the intensity of use, even to the detriment of aesthetic value of the grassland.

Key words: grassland, floristic analysis, forage value, evaluation of quality

Introduction

Vegetation because of its content of aboveground phytomass encroaches most part of our environment and creates the most important sustainable source for herbivores in the eco-

system. There are about 90 millions hectares of grassland under the complicated geo-ecological conditions of Europe (excluding Ukraine and Russia), and about 3 milliard in the world (Voigtländer-Jacob, 1987).

The pastures and meadows in mountains and foothills, which are used by agriculture are mostly multicomponental grass-herbage coenosis, consisting of plants in different combinations. The base of the forage quality from the grassland is its optimal composition – i.e. grasses (50-70%), legumes (15-25%) and the rest are other herbs. There are 50-60, and as high as 70 on the lime base, species registered on the agricultural grasslands. The assumption that everything green is good for forage is wrong. There are species with different forage value on the grasslands and meadows. It is highly necessary to know about this natural treasure, to use it efficiently and rationally, and at the same time to preserve it for future generations (Novák, 2000).

The evaluation of grassland quality is an unavoidable precondition for any agricultural research and pratotechnical intervention in practise. By the means of exact laboratory methods as quantification of the amount of water, concentration of energy (pertinently digestibility), proteins, carbohydrates, fat, fibre (lignin), minerals, essential oil, dietetic, toxic, vitamin, remedial matters, etc. further by anatomic and morphological structure (appearance of trichoms, fluffs, thorns, ligneousity), share of leaves, digestibility, tastiness, appeal for animals, it is not possible to give a true picture of the total quality of multifarious grassland, because each sample has specific composition of plant species, and therefore the number of samples should be bigger. The general tendency of laboratory methods is to overestimate the real quality of most plants as well as the aboveground biomass of grasslands. Moreover, chemical analyses are very expensive. Chemical analyses are oftentimes useless, mainly in case of higher content of inferior species on the grassland. Sclerenchymatic tissues of these species create indigestible ballast, since they pass through the digestive tract of animals without any change. The content of indigestible ballast in the leaves of quality grasses is max. 16% in the phase of vegetation (digestibility coefficient 84-89%), the leaves of weed species content 35-57% of ballast and their digestibility is 43-65% (Regal, 1956). The simplest evaluation of grassland from a floristic point of view is needed for practice, to set the quality and forage value. The most inexpensive method is a method of estimation based on botanical composition, which enables us to set the quality of forage accurately, without demanding chemical analyses. The most objective method seems to be a combination of chemical analyses and evaluation of the quality, on the base of floristic composition and forage values of individual plant species in the evaluated grassland.

The tradition of exploitation phytocoenology in agriculture is very old (Moravec et al., 1994). Field methods of evaluating grassland quality based on the approximation method of floristic structure can be found in literature. There are also well known scales for forage values of individual plant species and grassland classification. Albrecht von Thaer (1810) was the first author who published the list of grassland plants, later other authors continued: De Vries et al. (1942) in the low-land conditions of Holland; Ellenberg (1952) in Germany, then Klapp et al. (1953), Stählin (1971) and Opitz von Boberfeld (1994), in Czechoslovakia Regal (1958 in Regal, Krajčovič, 1963) and Jurko (1990), in Yugoslavia Šoštarič-Pisačič, Kovačevič (1974). Disunity in the choice of criteria and subjective opinions of the

authors are the main reasons of frequent diametrically different data about individual species. De Vries et al. (1942) gave the evaluation of 169 plant species on the scale 0-10, and then he sorted them accordingly to their quality from toxic and deleterious to the highest quality ones. The method by the authors Klapp et al. (1953) is still used in German speaking countries. It sorts plants according to their forage value into nine groups (from -1 to 8). In Czechoslovakia Regal (1958 in Regal, Krajčovič, 1963) sorted them into six quality groups (from – 1 to 1), Šoštarič- Pisačič, Kovačevič (1974) in the co-operation with Stählin used nine groups (from – 1 to 8) and Jurko (1990) eight (from – 3 to 5). On the base of floristic composition regarding percentage of yield and forage values, Klapp et al. (1953) sorted associations of grassland plants into hygrophytes, xerophytes, low and rich in nutrients. Regal (1958, in Regal, Krajčovič, 1963) sorted meadow and pasture plants into six quality groups for hay, meadows and pastures, where the 1st class includes the species of excellent quality and the last – the 6th class – deleterious up to toxic species. The percentage of projective dominance of individual species is the base of evaluation. So the forage value of the grassland is given in points by the sum of all the classes. Stählin (1971) sorts 1057 species accordingly to the evaluation of quality to Monocotyledonae (grasses and others monocotyledonous species), Dicotyledonae (legumes and other dicotyledonous species) and plants producing spores (pteridophyte ferns, mosses). He figures out the percentages of the species in the grassland before and after flowering period in fresh condition, in silage and hay, and gives the evaluation in points. The highest value is 100; in some cases, if the percentage of toxic species in grassland is high, the value can be very low below 0 (– 300 and lower). The authors Šoštarič-Pisačič, Kovačevič (1974) designed a complete method of evaluation, which includes 970 plant species in green stage before and after flowering period, and also in hay, withal they evaluated different factors, including site, influence of fertilisers, diversity of species, influence of exploitation on the forage value of grasslands, with corrections during the final evaluation of quality. All the methods which have been published are very complicated for application in practice. The effort is focused on simplifying the forage evaluation of grasslands to make it practical, simple, pertinent and easily understood for research and wide agricultural community, taking into consideration also the environmental and landscape creating points of view.

Material and methods

This paper has a methodical character. It was verified during 10 years (1992-2002) on 1200 analysed sites in the West Carpathians. Examined areas (altitude ranging from 370 to 1150 m with various acclivity up to 25o) are situated mainly on flysch sediments and weathered layers of cristalline rock (granite, paragneiss and others). The soils are mainly acid, up to strongly acid, alkaline only in case of application of lime soil substrates, mainly from medially heavy to heavy, here and there lighter, mostly clay loam, on some places with gravely structure. The predominant types of soil are Cambisols, Podzols, eventually Planosols or Gleyosols, on some places in the Orava region Histosols. The soils mostly content sufficient amounts of potassium, but insufficient amount of phosphorus.

For the evaluation of grassland quality it is necessary at first to find out the percentage of coverage (D – dominance) for different plant species in floristic groups in percentage. The best way is to make floristic

analyses on the area of 1 m² in four runs, and then on the whole area. If the ground cover is homogeneous, floristic analysis corresponds with one type of cover and area approximately up to 25 m². The higher plants on the grassland will be sorted to the subdivisions Spermatophyta (flowering plants), Pteridophyta (pteridophyte ferns) and Bryophyta (bryophytes). The subdivision Spermatophyta is the most numerous one, and it can be further divided into the classes Monocotyledoneae and Dicotyledoneae, which is the most numerous one. Under the Monocotyledoneae also comes the most numerous order Poales with the family Poaceae, the order Cyperales with the family Cyperaceae and the order Juncales with the family Juncaceae, and also other Monocotyledoneae from the subclass Liliidae with the families Liliaceae, Orchidaceae and Iridaceae. There are 6 floristic groups studied on the grassland:

1. Monocotyledoneae – grasses (Poaceae)
2. Monocotyledoneae – families sedge (Cyperaceae) and rush (Juncaceae) – species similar to grasses
3. Monocotyledoneae – families Liliaceae, Orchidaceae and Iridaceae
4. Dicotyledoneae – leguminous plants (Fabaceae)
5. Dicotyledoneae – other families of dicotyledonous species
6. Pteridophyta – pterydophyte ferns (Aspidiaceae, Equisetaceae, Hypolepidaceae), and the rest are Bryophyta (mosses) + empty places.

The estimation of coverage is given in percentage. The species, aboveground biomass of which do not reach 1% are marked by a symbol +. The sum of coverage of individual components together with empty places gives 100%. At first we find out the percentage of mosses and empty places, then gradually other floristic groups from the lowest coverage up to grasses, which are the most numerous, but at the same time the most problematic, as they are scattered among other species. This way a real image of completeness and density of ground cover can be acquired. This method can be used for evaluation of semi-natural grassland throughout the whole vegetation, particularly on the pastures, because the ground cover is after the regular grazing shorter than the ground cover of meadows, howerer these can be evaluated as well. The estimation of the ground cover of meadows is best done the first time before mowing, and then for higher precision one – two weeks after mowing, to detect plants in lower levels and mosses with empty places. If the first estimation of the floristic analysis is higher than 100%, it will be necessary to check the accuracy of the estimation, sum up the percentage of the coverage of individual species in floristic groups, and modify the values in percentage to reach the final 100%. The setting of the structure of the aboveground biomass in percentage is similar to the Klapp's method (Klapp, 1965), but it does not include the participation on the biomass yield and empty places, and at the same time elements of Regal (in Regal, Krajčovič, 1963) are introduced. The analysed floristic sample should be homogeneus and form one association on the area about 25 m². The evaluation covers the food offer for most herbivores in grass ecosystem, which means first of all farm animals, however it is possible to include game. The offer of other herbivores is difficult to be recorded. The evaluation consider valuable biotops, which serve as the source for the recover of functional grass ecosystem.

There is subsistent forage value from the 13 point scale (from – 4 to 8) for every plant species. 8 is given to the highly valuable species and – 4 to the toxic ones. The list of species with highest occurrence on the agricultural grassland with their forage value (FV) is given in Table 1. It is based on the forage values by the Klapp et al. (1953), which were corrected by Opitz von Boberfeld (1994) in the case of three species. The list is modified and completed by new plant species. For the computation of the total quality of the ground cover the following equation is used:

$$E_{GQ} = \frac{\Sigma (D.FV)}{8},$$

where E_{GQ} – evaluation of grassland quality
D [%] – predominance of species in %
FV – forage value of species.

The scale of the values from – 4 to 8 can be stretched to the scale – 50 to 100, to obtain the values suitable for practical use, where the low values mean low quality and the high values, up to 100, high quality of evaluated grassland. The value – 4 from the original scale corresponds with the value – 50 in the new scale. The linear transformation for such mapping is given by the pair of equations:

Table 1. The list of the most frequent plant species on the agricultural grassland with their forage value (FV)

SPERMATOPHYTA			
Monocotyledoneae			
Poaceae			
Species	**FV**	**Species**	**FV**
Agrostis canina L.	3	*Festuca pratensis* Huds.	8
Agrostis capillaris L.	5	*Festuca rubra* L. ssp. rubra	5/3
Agrostis gigantea Roth	7	*Festuca rubra* L. ssp. commutata	4/3
Agrostis stolonifera L.	6	*Holcus lanatus* L.	4/3
Alopecurus pratensis L.	7	*Hordeum murinum* L.	2
Anthoxanthum odoratum L.	3	*Lolium multiflorum* Lam.	7
Arrhenatherum elatius (L.) P. Beauv.	7	*Lolium perenne* L.	8
Avenella flexuosa (L.) Parl.	3	*Molinia caerulea* (L.) Moench and	
Avenula pratensis (L.) Dumort	2	other	2
Avenula pubescens (Huds.) Dumort	4	*Nardus stricta* L.	2/1
Brachypodium pinnatum (L.) P. Beauv.	2	*Phalaroides arundinacea* (L.)	
Briza media L.	5	Rauschert	5
Bromus erectus Huds.	5	*Phleum phleoides* (L.) H. Karst.	3
Bromus hordeaceus L.	3	*Phleum pratense* L.	8
Bromus inermis Leyss.	5	*Phragmites australis* (Cav.) Trin.	2
Bromus racemosus L. and other	4	*Poa annua* L. and other	5
Calamagrostis epigejos (L.) Roth and other	2!	*Poa bulbosa* L.	3
Cynosurus cristatus L.	6/5	*Poa chaixii* Vill.	2
Dactylis glomerata L.	7	*Poa compressa* L.	3
Danthonia decumbens (L.) DC.	2	*Poa nemoralis* L.	5
Deschampsia caespitosa (L.) P. Beauv.	3/1	*Poa palustris* L.	7
Elytrigia repens (L.) Desv. *	4	*Poa pratensis* L.	8
Festuca arundinacea Schreb.	4/2	*Poa trivialis* L.	6/4
Festuca ovina L. and other	3	*Sesleria caerulea* (L.) Ard.	2
		Stipa joannis ? elak. and other	2
		Trisetum flavescens (L.) P. Beauv.	6/4
Monocotyledoneae			
Cyperaceae		**Juncaceae**	
Carex montana L. and other	1!	*Juncus conglomeratus* L.	1!
Carex panicea L. and other	2!	*Juncus effusus* L. *	1!
Eriophorum sp.	1!		
Luzula luzuloides (Lam.) Dandy et			
Wilmott	2/1		
Luzula sylvatica (Huds.) Gaudin	2/1		
Scirpus sylvaticus L.	2/1		
Monocotyledoneae			
Iridaceae		**Liliaceae**	
Crocus heuffelianus Herb.	-2	*Allium sp.* *	-3
Gladiolus imbricatus L. and other	0	*Anthericum ramosum* L.	-1
Iris sp. *	-1	*Colchicum autumnale* L. *	-4
		Gagea lutea (L.) Ker Gawl.	0
		Muscari sp.	-4
		Ornithogalum umbellatum L.	-2
Orchidaceae		**Amaryllidaceae**	
Dactylorhiza sp.	-1	*Galanthus nivalis* L.	-1
Gymnadenia conopsea (L.) R. Br.	-1	*Leucojum vernum* L. and other	-2
Listera ovata (L.) R. Br.	0		
Orchis sp.	-1		
Platantera bifolia (L.) Rich.	-1		
Veratrum album L. *	-4		

Table 1. (Continued)

Dicotyledoneae Fabaceae			
Anthyllis vulneraria L. *	5	*Onobrychis viciifolia* Scop.	7
Astragalus glycyphyllos L. *	7	*Ononis arvensis* L. *	0
Coronilla varia L. *	-3	*Ononis spinosa* L. *	-2
Galega officinalis L. *	4 !	*Trifolium arvense* L.	4
Genista tinctoria L. * and other	0	*Trifolium campestre* Schreb. and other	4
Lathyrus palustris L.	5/4	*Trifolium dubium* Sibth.	6
Lathyrus pratensis L.	7/5	*Trifolium flexuosum* Jacq.	4
Lathyrus sylvestris L.	7/5	*Trifolium fragiferum* L.	7
Lathyrus tuberosus L.	7/5	*Trifolium hybridum* L.	6
Lotus corniculatus L.	7/5	*Trifolium montanum* L.	5
Lotus uliginosus Schkuhr	7/5	*Trifolium pratense* L. *	7
Medicago falcata L.	6	*Trifolium repens* L.	8
Medicago lupulina L.	7	*Vicia cracca* L.	6/5
Melilotus albus Medik.	3 !	*Vicia hirsuta* (L.) Gray	5/4
Melilotus officinalis (L.) Pall. *	3 !	*Vicia sepium* L. and other	6/5
Dicotyledoneae Other families with herbs			
Acetosa pratensis Mill. *	2 !	*Lamium purpureum* L. and other	2 !
Acetosella vulgaris Fourr.	2 !	*Leontodon autumnalis* L.	5/4
Aconitum firmum Rchb. *	-4	*Leontodon hispidus* L.	5/4
Aegopodium podagraria L. *	3	*Leucanthemum vulgare* Lam.	2
Agrimonia eupatoria L.*	2	*Linaria vulgaris* Mill. *	-2
Achillea millefolium L. * and other	5/3	*Lychnis flos-cuculi* L.	1 !
Ajuga reptans L. *	2	*Lysimachia nummularia* L.	1
Alchemilla sp. *	5	*Malva neglecta* Wallr.	3
Anchusa officinalis L. *	2 !	*Matricaria discoidea* DC	2
Angelica sylvestris L.	2 !	*Melampyrum nemorosum* L.	0
Antennaria dioica (L.) Gaertn.	1	*Mentha arvensis* L. and other	0
Anthriscus sylvestris L. Hoffm.	4	*Mentha longifolia* (L.) L.	0
Arctium lappa L. *	0	*Myosotis sp.*	2
Arctium tomentosum Mill. *	0	*Odontites vulgaris* Moench	-1
Armoracia rusticana P. Gaertn., B. Mey. et Scherb. *	2 !	*Origanum vulgare* L. *	1
Artemisia vulgaris L. * and other	1 !	*Orobanche sp.*	-1
Barbarea vulgaris R. Br.	2 !	*Pastinaca sativa* L. *	4/2
Bellis perennis L. *	2	*Pedicularis verticiliata* L. and other	-3
Betonica officinalis L. *	2	*Persicaria lapathifolium* (L.) Gray and other	1 !
Bistorta major Gray *	4	*Petasites hybridus* (L.) P. Gaertn., B. Mey. et Scherb. *	1 !
Bistorta vivipara (L.) Gray	3	*Phyteuma spicatum* L.	2
Calluna vulgaris (L.) Hull *	0	*Picris hieracioides* L.	1
Caltha palustris L. *	-3	*Pilosella bauhinii* (F. W. Schultz ex Besser) Arv.-Touv. and other	2
Campanula patula L.	3	*Pimpinella sp.* *	5/4
Campanula persicifolia L.	3	*Plantago lanceolata* L. *	6/4
Campanula rotundifolia L. and other	3	*Plantago major* L.	2
Capsella bursa-pastoris (L.) Medik. *	1 !	*Plantago media* L.	2
Cardamine pratensis L. *	-2	*Polygala amara* L. * and other	1
Cardaminopsis halleri (L.) Hayek	1	*Polygonum aviculare* L. *	1 !
Cardaria draba (L.) Desv.	2	*Potentilla anserina* L. *	1 !
Carduus sp.	0	*Potentilla erecta* (L.) Raeusch. * and other	1 !
Carlina acaulis L. *	-2	*Primula veris* L. * and other	2 !
Carlina vulgaris L.	0		
Carum carvi L. *	5/3		
Centaurium erythrea Raf n	2		

Table 1. (Continued)

Cerastium arvense L. and other	3	*Prunela grandiflora* (L.) Scholler	2
Chaerophyllum sp.	1 !	*Prunela vulgaris* L. *	2
Chamerion angustifolium (L.) Holub and other	2/1 2 !	*Pyrethrum corymbosum* (L.) Scop. and other	2
Chenopodium bonus-henricus L. * and other	1/0	*Ranunculus acris* L. * and other	-3
Cichorium intybus L. *	0	*Ranunculus repens* L.	-1
Cirsium arvense (L.) Scop.	4	*Reseda lutea* L.	2
Cirsium oleraceum (L.) Scop. *	0	*Rhinanthus sp.*	-2
Cirsium palustre (L.) Scop.	2/1	*Rorippa sylvestris* (L.) Besser	-2
Cirsium rivulare (Jacq.) All.	0	*Rumex alpinus* L.	2 !
Cirsium vulgare (Savi) Ten. and other	3/2	*Rumex crispus* L.	1 !
Colymbada scabiosa (L.) Holub and other	3 !	*Rumex obtusifolius* L.	1 !
Convolvulus arvensis L. *	4	*Salvia pratensis* L.	2 !
Crepis biennis L. and other	3	*Salvia verticillata* L.	2 !
Cruciata glabra (L.) Ehrend.	3	*Sanquisorba minor* Scop.	4/3
Cruciata laevipes Opiz	-2	*Sanquisorba officinalis* L. *	5/3
Cuscuta epithymum (L.) L. and other	-4	*Saxifraga granulata* L. *	2
Datura stramonium L. *	3/2	*Scabiosa sp.*	3/2
Daucus carota L. *	2 !	*Sedum acre* L. * and other	-2
Dianthus deltoides L. and other	-2	*Selinum carvifolia* (L.) L.	3
Echium vulgare L.	2/1	*Senecio jacobaea* L. and other	-4
Epilobium sp.	3	*Silene latifolia* Poir.	2 !
Erigeron acris L. and other	2	*Silene vulgaris* (Moench) Garcke and other	3/2
Erodium cicutarium (L.) L´Hér	-2	*Sinapis alba* L. and other	2 !
Eryngium campestre L.	-2	*Solidago virgaurea* L. * and other	2 !
Euphrasia rostkoviana Hayne * and other	-2	*Sonchus oleraceus* L.	4
Ficaria bulbifera Holub *	3 !	*Stachys sylvatica* L.	2 !
Filipendula ulmaria (L.) Maxim. *	3 !	*Stellaria graminea* L. and other	2 !
Filipendula vulgaris Moench	2	*Stellaria media* (L.) Vill. *	0
Fragaria vesca L. * and other	2 !	*Stenactis annua* (L.) Nees	2
Galeopsis sp. *	3/2	*Succisa pratensis* Moench	2
Galium mollugo L.	3/2	*Symphytum officinale* L. * and other	2 !
Galium uliginosum L.	3/2	*Tanacetum vulgare* L. *	-2
Galium verum L. * and other	2 !	*Taraxacum officinale* auct. non Weber *	5/4
Gentiana asclepiadea L.	2 !	*Thymus serpyllum* L. * and other	1 !
Gentiana cruciata L.	2 !	*Tithymalus cyparissias* (L.) Scop. and other	-3
Gentiana punctata L. * and other	2 !	*Tragopogon orientalis* L.	4/3
Gentianella amarella (L.) Börner	2 !	*Tragopogon pratensis* L.	4/3
Gentianella lutescens (Velen.) Holub	2 !	*Tripleurospermum perforatum* (Mérat) M. Lainz	2 !
Gentianopsis ciliata (L.) Ma	2	*Trollius altissimus* Grantz	-2
Geranium pratense L. and other	2	*Tusssilago farfara* L. *	1 !
Geranium pusillum Burm. f.	1	*Urtica dioica* L. *	1 !
Geum rivale L. and other	-2	*Vaccinium myrtillus* L. *	0
Glechoma hederacea L. *	1 !	*Vaccinium vitis-idaea* L. *	0
Helianthemum nummularium (L.) Mill.	5/3	*Valeriana officinalis* L. *	-2
Heracleum sphondylium L. *	2	*Verbascum sp.* *	1 !
Hieracium umbelatum L. and other	-1	*Veronica chamaedrys* L. and other	2
Hypericum maculatum Grantz	-2	*Veronica officinalis* L. *	1 !
Hypericum perforatum L. *	2	*Viola tricolor* L. emend. F. W. Schmidt*	1 !
Hypochaeris radicata L.	1 !	*Viola arvensis* L. and other	1 !
Inula britannica L. and other	3/2		
Jacea pratensis Lam. and other	2		
Knautia arvensis (L.) Coult. and other			

Table 1. (Continued)

PTERIDOPHYTA			
Equisetaceae		**Aspidiaceae**	
Equisetum arvense L. *	-2	*Dryopteris filix-mas* (L.) Schott *	-1
Equisetum palustre L.	-4	**Hypolepidaceae**	
		Pteridium aquilinum (L.) Kuhn	-4

* drug plants

$$8c = 100$$
$$-4c = -50$$

from what we have c = 100/8 = 12.5, where the value c is a normalizing coefficient (12.5). This constant can be used for direct conversion of the evaluation of plant quality in the original scale from – 4 to 8 to the more tabular scale from – 50 to 100.

It can be figured that the formula for the computation of the quality of the plant species in the dependence of its quantitative representation in the grassland (E_{SQ}), which determinates the values in the new scale is as follows:

$$E_{SQ} = \frac{D.FV}{100} \cdot c = \frac{D.FV}{8}.$$

For the result of the evaluation of the quality of the grassland the following formula will be used:

$$E_{GQ} = \frac{\Sigma (D.FV)}{8}.$$

It is the sum of the proportions of the quantity of the given species divided by 8 for every plant.

The first number in the column FV (Table 2) is the base for the quality evaluation of plants. The second number after a slash represents complementary values, which are lower in case of a big share (more than 10%). The marker ! says that in case of higher representation (more than 3%) the forage value may be inappropriate, deleterious up to highly deleterious. The forage values of individual plant species include criteria of tastiness and utility, share of soft, tender and full value parts, but also deleteriousness and toxicity. The plant species which are not stated in the table create just minimum or even vestigial share of the grassland. These are mostly species of low value, worthless or deleterious species, which do not significantly influence the resultant quality. It is possible to assign them the value of the similar plant from the given family. Statistic method of Paired two sample t-test for means was used for the evaluation.

Table 2. The scale of forage values (FV) of individual plant species

FV	Plant species
7 – 8	highly valuable – most valuable
6 – 7	valuable – highly valuable
4 – 6	less valuable – valuable
2 – 4	least valuable – less valuable
1 – 2	worthless – least valuable
0 – 1	deleterious – worthless
0 – –1	deleterious to slightly toxic
–1 – –3	slightly toxic to highly toxic
–3 – –4	highly toxic to death causing

Results and discussion

The evaluation of the grassland quality was verified on 1200 floristic analyses, out of which 800 were tested on conclusiviness on 57 farms The evaluation of the quality was realized on the farm farmed semi-natural grass-

lands, mainly used as pastures and meadows in the West Carpathian region, in which the number of floristic analyses was as follows: region Kysuce – 159, Považie – 45, Turiec – 34, Orava – 231, Liptov – 159, region of the upper Hron – 172, Spiš – 33.

The data of Míka (2002) can be used for the confirmation of the suitableness of the evaluation. It is stated, that botanical and chemical composition of the pastures compared with the meadow grasslands is more various, as well as the height, size and density of the plants. Floristic analyses can be done during the whole phase of vegetation, since the pastures are more frequently defoliated, they are in the growth stage from tillering to forming stems and the share of empty places can be found out better then on the meadow grasslands.

The predominating associations in the grasslands were *Lolio-Cynosuretum*, more rarely *Festuco-Cynosuretum, Agrosti-Festucetum*, here and there also *Anthoxantho-Agrostietum*, pertinently *Trisetetum* and *Nardetum*. The floristic group of grasses was in average 38.30% (optimal value 50-70%) and leguminoses 13.20 (optimal value 15-25%). Grasses and leguminoses together created just 52%, which form the base for the quality evaluation, as the main high forage value components of grasslands. Other herbs formed the rest, on the more extensive areas was registered bigger share of *Cichorium intybus, Galeopsis sp., Galium sp., Jacea pratensis* and *Tanacetum vulgare*. On many sites there was a share of weed species, mainly *Arctium lappa, Arctium tomentosum, Capsella bursa-pastoris, Carduus acanthoides, Cirsium arvense, Cirsium vulgare, Rumex obtusifolius, Rumex crispus and Urtica dioica*, up to very weedy sites. Phytodiversity was in average 35 species. E_{GQ} reached from the 100-point scale values of 59.80. The sites were mainly very sparse (15.80% of barren places).

The final value of 76.61 in the Table 3 denotes the fact, that the grassland is accordingly to the range (Table 3, 4) valuable. The acquired results were compared with Regal (in Regal, Krajčovič, 1963), whose scale is similar. His coefficients of bonity classes (from – 1 to 1) have the scale narrower, that is re-

Table 3. Example of calculation E_{SQ} a E_{GQ} of typical pasture ground cover

Plant species	D [%]	FV	E_{SQ}
Lolium perenne	22	8	22.00
Trifolium repens	19	8	19.00
Taraxacum officinale	7	5	4.37
Festuca pratensis	6	8	6.00
Poa pratensis	5	8	5.00
Cynosurus cristatus	5	6	3.75
Festuca rubra	4	5	2.50
Carum carvi	4	5	2.50
Achillea millefolium	3	5	1.87
Poa trivialis	3	4	1.50
Lentodon autumnalis	3	5	1.87
Tragopogon pratensis	2	4	1.00
Trifolium pratense	2	7	1.75
Phleum pratense	2	8	2.00
Alchemilla vulgaris	2	5	1.25
Ranunculus repens	1	–1	–0.12
Plantago lanceolata	1	–3	0.75
Ranunculus acris	1	2	–0.37
Prunella vulgaris	1	–	0.25
Mosses, empty places	8	–	–
E_{GQ}	100	–	76.61

Table 4. Evaluation of the grassland quality in points

E_{GQ}	Grassland
90 – 100	highly valuable – most valuable
70 – 90	valuable – highly valuable
50 – 70	less valuable – valuable
25 – 50	least valuable – less valuable
15 – 25	worthless – least valuable
0 – 15	deleterious – worthless
< 0	toxic

flected by the graph (Figs 1-4). Tested values of E_{GQ} were in 9 cases not significant, in 4 cases they were significant and in 40 cases highly significant, there the final results are highly significant as well. There were registered higher point values by Regal on most tested sites. The values by Regal (E_R) are higher than the values of E_{GQ} in average by 7.55% (Table 5).

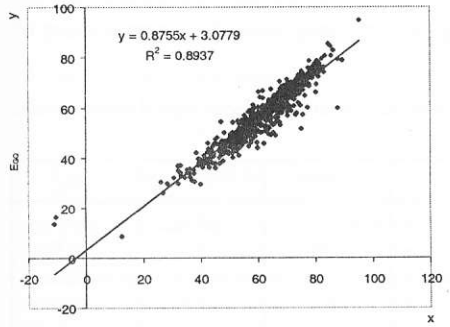

Fig. 1. Dependence of values E_{GQ} on E_R (Regal's) values.

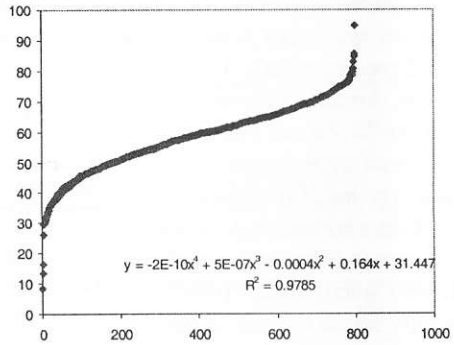

Fig. 2. Trend of values E_{GQ}.

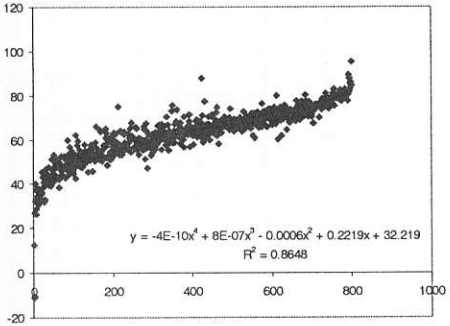

Fig. 3. Trend of E_R (Regal's) values.

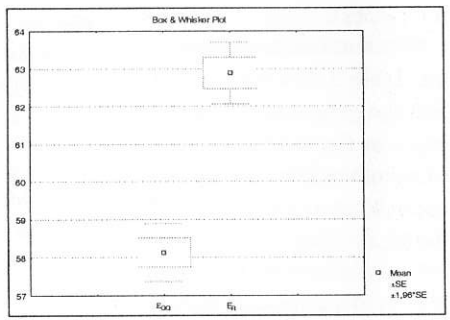

Fig. 4. Mean value E_{GQ} and E_R (Regal's) values.

Highly valuable and valuable plants (FV from 7 to 8) are for the animals tasty and worthwhile, with high share of proteins and soluble sugars, as well as appealing flavour. Highly valuable grass species (*Festuca pratensis*, *Lolium perenne*, *Phleum pratense*, as well as *Poa pratensis* and *Dactylis glomerata*) and leguminoses (*Trifolium repens a Trifolium pratense*) which form sufficient share of the grasscover of the pastures have the highest FV, except for *Dactylis glomerata a Trifolium pratense,* with the FV = 7. Regal (in Regal, Krajčovič, 1963) does not distinguish them and ranks them into the same bonity class, Jurko (1990) gives *Dactylis glomerata* lower value, but he does not distinguish leguminoses. Since *Dactylis glomerata* grows older and harder (serrated edges of the leaves) very quickly, the content of its fibre rises, the recommended share of it on the pastures is at most 10%. Some species, which are by the authors Kalač, Míka (1988), favoured by animals, content alkaloids, e.g. *Lolium perenne,* which contains lolitrein, causing vertigo during late summer high temperatures ('summer syndrome'), further leguminoses *Trifolium repens* and *Trifolium pratense,* except for *Lotus corniculatus,* which cause the accumulation of gasses and lather in the rumen. Therefore it is necessary to respect the advised share of *Lolium perenne* and *Trifolium repens,* which is up to 25 %, in case of *Trifolium pratense* at most 5%.

Table 5. Paired two sample t-test for means

Value	E_{GQ}	E_R
Botanical analysis	800	
Minimum	8.50	
Maximum	94.75	800
Sum	46507.88	-11
Mean	58.13	95.25
Variance	119.80	50308.68
Pearson correlation	0,94	62.89
t stat	-34.81	139.67
P(T<= t) (1)	1.43E-162	++
t krit (1)	1.65	
P(T<= t) (2)	2.86E-162	
t krit (2)	1.96	

Tasty plants in full-value condition which contain a high share of proteins and soluble sugars, aromatic and tasty for the animals are ranked to highly valuable up to most valuable. The cultivated intergeneric hybrids (*Festulolium*), which can be lolioid (with dominance of the species *Lolium*) or festucoid (with dominance of the species *Festuca*) are not included into the list. Their forage value is the mean of the combination of original species from which the hybrid was cultivated, the lowest for the hybrid combined with *Festuca arundinacea*. Their lower FV corresponds with the authors Kalač, Míka (1988), Míka (2002), who mentioned the high content of alkaloid perlolin becoming from the endophytes of fungus *Acremonium sp.*, from the class *Fungi inperfecti*, causing so called 'summer syndrome', which results in lower profitability of the animals). According to the latest results (Galler, 1989; Pötsch, 1999) some of the relatively valuable species, as e.g. *Trisetum flavescens,* in high numbers can cause calcinosis of the cattle. Evaluation of this species by Klapp et al. (1953), Regal (in Regal, Krajčovič, 1963) and Stählin (1971) is relatively high. We incline to the lower values by Jurko (1990) and Opitz von Boberfeld (1994).

Less valuable up to valuable species (FV from 4 to 6) may become facultative weeds in case of their higher percentage share in the grass cover. Their categorisation into the weeds depends on the amount, phase of growth and condition during the forage. The means of the valuable species according to the floristic analysis varied between 1.53 and 4.37% sequencing: *Plantago lanceolata, Alchemilla sp., Carum carvi, Leontodon sp., Achillea millefolium* and *Taraxacum officinale.* The results of Scehovič (1995), who indicates for these species higher values, i.e. slightly above the marginal values of 120 IANP (Index of potential negative activity), are respected as well. These species are favoured by the animals, however in case of their higher share in some sporadic areas, they cause the decrease of the forage value of the grassland, therefore we recommend this share to be lowered. The most frequent valuable species *Taraxacum officinale* is in fresh state acceptable component of the grassland up to its 5% share. It is tolerated species to 10% share, as it supports milk creation, however it tastes slightly bitterly, and in case of the share above 10% it is less convenient component from the productivity, quality of forage and diethetical points of view. In hay the leaves of this species crumble away very quickly and consequently the forage loses its nutrients and thus its FV.

Worthless, pertinently deleterious species (FV from 2 to 0) in case of their higher share radically lower the forage value, adulterate forage and create the weed component of the grassland. Into this group there can be also included the plants with low leaf rosette (FV from 1 to 2), appearing on the sites which are heavily trampled, and so they are reachable neither by the grazing animals, nor by the mowing machines, e.g. *Bellis perennis, Plantago major, Potentilla anserina* and others. There are the weeds, which present warning danger even in case of low amounts, with high reproductive coefficient (international code +++), e.g. *Anthriscus sylvestris, Arctium sp., Cirsium sp., Chenopodium bonus-henricus, Rumex sp., Urtica dioica* and others. They can also appear in so called 'nests' and it is necessary to evaluate them separately. There are registered within this group also the plants, which are in the case of their higher percentage considered ruderal weeds. They form faciaes (groups) with different combinations and percentages of individual species. Their sites are excessively burdened and overmanured by cattle excrements (cattle folds, cattle shelters), pertinently the sites overmanured by liquid manure or farmyard manure with high content of nitrogen and potassium. The plants which cause mechanical damage to the digestive organs of animals (FV = 0), e.g. *Carduus sp., Calluna vulgaris, Carlina acaulis, Cirsium arvense, Genista sp., Ononis spinosa, Vaccinium myrtillus, Vaccinium vitis–idaea* and others are also included into this group.

Special attention should be paid to toxic species (FV from – 1 to – 4). In the agreement with the authors Kalač, Míka (1988), Frantová, Ofúkaný (1990) and Míka (2001), we consider the toxic species to be dangerous, requiring special attention when evaluating the grassland. The number of poisonings and toxicoses of domestic animals caused by toxic plants, which has recently dramatically grown, supports this idea. The danger of long-term toxicoses should not be underestimated, even though their forms are various and thus the identification of their sources is very difficult. In case of their considerable share in the forage they cause direct and non-direct losses; they cause the harm to the animal organism,

influence neural system, induce the inflammation of digesting system, colics, irritation and damage of kidneys, they disturb acido-basic conditions, induce acidosis, toxicosis, even seldom death loss. Their impact on the final products – milk and meat, that can be toxic or at least not convenient for people is not neglectable either. Economic consequences of damages caused to animals and people by chronic toxicosis are at present bigger that those of contagious diseases.

Little attention is paid to toxic plants in practise. However far-size share of the plants on the grasslands have toxic impact. They can grow sporadically, nevertheless their appearance in 'nests' is more dangerous. They can occur during extensive exploitation of the pastures, and they can appear yet on the places they have never grown before. Some of them have the character of invasive species, e.g. *Datura stramonium,* which can as a nitrofil species in the form of seeds (as a part of corn seed) get by the application of manure from the lowlands to the areas near the farms in the mountain and foothill regions.

The active substances of the toxic plants occur either in the whole plant, or in their parts. Their content in the plants is not always the same, it depends on the conditions of the sites, mostly the chemical composition of the soil, weather conditions, season, growth phase in the time of harvest, as well as on the kind of preservation of the aboveground biomass. The active substances of most of the toxic plant influence the neural digesting systems. Some venom are eliminated from the animal body, others are broken into less toxic matters, but in some cases they can be on contrary changed to even more toxic ones.

As the adult animals can distinguish the toxic species, they leave them on the pasture as the residual herbage, therefore they are rarely poisoned directly on the pasture. However, in the form of fresh mown forage, silage or hay they can be barely distinguished. Only in some cases (*Ranunculus acris*) the toxic plants lose their toxicity in the form of hay.

Toxic species most common in the grass cover (*Cardamine pratensis, Colchicum autumnale, Euphrasia rostkoviana, Equisetum palustre, Odontites vulgaris, Ranunculus acris, Rhinanthus minor, Senecio jacobaea, Tithymalus cyparissias*) appeared on the analysed sites on average in share of tenths or hundredths per cent and just locally in higher share. They contain toxic alkaloids, influence digestibility of organic biomass, that results in the fact, that they are less grazed on the pastures, or are not grazed at all, and therefore are left on the pasture ungrazed. They destruct acidobase environment, influence neural system and cause acidosis, toxicosis and rarely death loss. Their categorization into the weeds depends on their numerousness, growth phase and condition during feeding. Special attention should be paid to semiparasitic plants, e.g. *Euphrasia rostkoviana, Odontites vulgaris, Rhinanthus minor* and others, parasitic plants, e.g. *Cuscuta epithymum, Orobanche sp.* and others.

Morphological characteristics and anatomical structure of the plants (thorns, prickles, hairiness, trichoms, coriaceous leaf epidermis and others) can be considered the main factors influencing the decrease in forage quality. During selective grazing the animals prefer leaves to stalks. If compared with leguminoses and sappy species of other plants, the grass species with higher content of sclerenchym cells, silica, hemicellulose, lignin and pectin have lignified parenchym and incrusted vascular bundles of old grass stalks after the stage

of flowers, and thus are less digestible. In addition to the majority of grasses some herbs, e.g. *Achillea sp., Carum carvi, Cichorium intybus, Daucus carota, Jacea pratensis, Salvia sp.* and others become lignified in the growth stages of flower formation, flowering and termination of the flowering period very quickly, too. Ruminant animals, which need max. 25 % of fibre avoid grazing them, thus they stay on the grassland in the form of residual herbage. In the following years after their dissemination their share even increases. Other factors are their chemical features, as malodour, astringent taste, higher content of ether oils, secondary metabolites (alkaloids, coumarins, carotenes, cyanogenic glucosides, flavonoids, phenol acids, anthokyans, acetylens, glukosinolates, lignans, lignins, terpens, tannins) and others.

Phenolic matters show wide range of chemical structures, since each of the floristic groups (grasses, herb leguminoses, other herbs have specific representation. During the phylogenetic evolution they had an important role protecting the plants against consumers insects. Phenolic matters decrease the tastiness, forage reception, utilization of nutrients, they influence the growth, health (antinutrients), moreover in higher concentrations they can be even toxic for the rumen micloflora of the animals (natural toxicants), endangering their health yet their lives. In case of the high share the phenolic matters in the forage with the content of tannins e.g. *Geranium pratense, Leucanthemum vulgare, Potentilla anserina, Veronica chamaedrys* and others, can the reception of them cause even long-lasting toxicoses.

Drug plants (in Table 1 marked by *) are numerous among the meadow and pasture plants. Their marking in Table 1 is the result of a compromise of the data by different authors (Kresánek et al., 1977; Pamukov, Achtardžiev, 1986; Mika, 1991; Kováč, Kováčová; 2001, Pahlow, 2001). The active matters, which can be found in different aboveground parts of the plants have in moderate amounts positive dietetic effects on digestion, metabolism, and health condition. They have also pharmacological effects: antibacterial during healing the wounds of digesting system, mainly intestinal walls, tissue regeneration, inflammation of respiratory system and other parts of body, some of them decrease the level of cholesterol in blood, resp. have antiallergenic effects. Medicinal effects of aboveground organs help the cattle to overcome digestion and breathing problems. The effects of underground organs of some species (*Bistorta major, Elytrigia repens, Symphytum officinale* and others) can be utilised during grazing. The animals on the pasture avoid many toxic or deterogeneous drug plants.

Many species cause allergy during the flowering period. In case of higher content of the active matters they take effect of contact allergens, which cause skin inflammation e.g. *Polygonum aviculare, Ranunculus sp., Tithymalus sp., Urtica dioica* and other, others cause phototoxical allergy, e.g. *Anthriscus sylvestris, Heracleum sphodylium, Hypericum perforatum, Leucanthemum vulgare, Pastinaca sativa* and others. During the flowering period some species can cause pollen allergy. The majority of grasses belongs to this group, except for *Avenula sp., Briza media, Deschampsia caespitosa, Festuca rubra* and *Nardus stricta*. The leguminoses are not allergens, nevertheless from other valuable plants allergy can be caused by, e.g. *Achillea millefolium, Leontodon hispidus, Plantago lanceolata* and

Taraxacum officinale, from the group of low valuable and worthless species *Acetosa pratensis, Artemisia vulgaris, Arctium lappa, Bellis perennis, Carex sp., Cichorium intybus, Daucus carota, Fragaria sp., Heracleum sphondylium, Leucanthemum vulgare, Plantago major, Plantago media, Polygonum vulgare, Rumex sp.* and *Urtica dioica* and from deleterious and toxic e.g. *Hypericum sp., Mentha longifolia, Ranunculus acris, Ranunculus repens, Tanacetum vulgare* and *Tithymalus cyparisias*. After the termination of the stage of flowering, during the grow stage of seed forming the seeds of *Sinapis sp., Vicia sp.* and others can deleteriously influence the animal organism. The allergic influence of some species in ecosystem can be eliminated by grazing of the pasture grassland during the optimum growth stage from tillering to forming stems, and by mowing the meadows before the flowering of the allergenic species.

The valuable and quality grass cover should not contain toxic, semiparasitic and parasitic plants. Maximally 3% of the species with FV from 0 to 2, five percent of the species with the FV from 2 to 4 and up to 10% of the species with the FV from 4 to 6 are tolerated. We consider *Ranunculus acris* for toxic species (FV = – 3), in disagreement with Klapp et al. (1953), who denotes FV = 1. We tend to agree with the values by Jurko (1990) and Stählin (1971), who tolerates their share up to 5 %. We agree with Regal (in Regal, Krajčovič, 1963), Jurko (1990) and Opitz von Boberfeld (1994), who denotes high toxicity in green stage. Our evaluation of *Ranunculus repens* is similar and on the base of high IANP by Scehovic (1995) also the evaluation of *Hypericum perforatum* and *Hypericum maculatum*. The forage values of other species after the slashed line in the Table 1 form the compromise among Klapp et al. (1953), Regal, Krajčovič (1963), Stählin (1971), Jurko (1990) and Opitz von Boberfeld (1994), complemented by our own opinion acquired during the observation of grazing animals on the pastures.

The forage industry does not have any problems with quantitative parameters when processing the grass cover, the only remaining problem is the quality. In the grassland there can be found the species, which are not very productive, however they are highly valuable for the nutrition of animals. The evaluation of the grassland quality is highly topical, because in its current transition to the extensification there appears to be a big share of empty places (sometimes up to 20%) and weed species, which sharply downgrade the value of the grassland. This fact cannot be left unnoticed. Objective survey of positive or negative trends cannot be done without analyses of species. The evaluation of the grassland quality can be done by the verified computer programme Excel and this will give the base for the powerful decision about radical or partial revitalisation of the grassland, or revitalisation by additional seeding of clover-grass mixture to increase its forage value. The quality evaluation of the food offer in a grass ecosystem is possible to be quantified for farm animals and game, nevertheless in case of other herbivores which take part in the consumption within the food chain it is possible just theoretically.

Translated by K. Veselá

References

Ellenberg, H., 1952: Wiesen und Weiden und ihre standörtliche Bewertung. 2. Verlag Eugen Ulmer, Stuttgart z. Z. Ludwigsburg.

Frantová, E., Ofúkaný, L., 1990: Poisonous plants (in Slovak). Vydavateľstvo Obzor, Bratislava, ISBN 80-215-0061-1.

Galler, J., 1989: Grünlandverunkrautung. Leopold Stocker Verlag Graz-Stuttgart, ISBN 3-7020-0555-2.

Hausen, B.M., Vieluf, I.K., 1997: Allergiepflanzen, Handbuch und Atlas. Nikol Verlagsgesellschaft mbH & Co. KG Hamburg. ISBN 3-933203-48-1.

Jurko, A., 1990: Ecological and socio-economic evaluation of vegetation (in Slovak). (Ökologische und sozioökonomische Bewertung der Vegetation.) Príroda, Bratislava, ISBN 80-07-00391-6.

Kalač, P., Míka, V., 1988: Natural noxious substances in crop forage (in Czech). Ministry of agriculture and nutrition of Czech republic. Organisation of Czech republic in agriculture and nutrition. České Budějovice.

Klapp, E., Boeker, P., König, F., Stählin, A., 1953: Wertzahlen der Grünlandpflanzen. Das Grünland, *2*, 5, p. 38-42.

Klapp, E., 1965: Grünlandvegetation und Standort. Verlag Paul Parey – Berlin und Hamburg.

Kováč, P., Kováčová, M., 2001: Book of recipes for medical herbs in veterinary medicine (in Slovak). Vydavateľstvo VA PRINT, Nitra, ISBN 80-968256-4-X.

Kresánek, J. et al., 1977: Atlas of medical herbs and berries (in Slovak). Vydavateľ. Osveta, Martin.

Marhold, K., Hindák, F., 1998: Checklist of non-vascular and vascular Plants of Slovakia. Veda, SAV Bratislava, ISBN 80-224-0526-4.

Mika, K., 1991: Phytotherapy for dostors (in Slovak). Vydavateľ. Osveta, Martin, ISBN 80-217-0349-0.

Míka, V., 2001: Phenolic substances in meadow plants (in Czech). VÚRV, Praha, ISBN 80-86555-07-0.

Míka, V., 2002: Morfogenesis of grasses (in Czech). VÚRV, Praha, ISBN 80-86555-20-8.

Moravec, J. et al., 1994: Phytocoenology (in Czech). Academia, Praha, ISBN 80-200-0128-X.

Novák, J., 2000: Ekosystems of fodder plants (in Slovak). Ochrana biodiverzity. SPU, Nitra, ISBN 80-7137-734-1.

Opitz von Boberfeld, W., 1994: Grünlandlehre. Biologische und ökologische Grundlagen. Verlag Eugen Ulmer, Stuttgart, ISBN 3-8252-1770-1.

Pahlow, M., 2001: Das grosse Buch der Heilpflanzen. Verlagsgruppe Weltbild GmbH Augsburg, ISBN 3-8289-1839-5.

Pamukov, D., Achtardžiev, Ch., 1986: Natural pharmacy (in Slovak). Vydavateľstvo Príroda, Bratislava.

Pötsch, E.M., 1999: Fight against enzootic calcinosis (in Czech). Pastvina a zvíře. MZLU Brno, p. 19-23.

Regal, V., 1956: The Microscopic Method for Evaluating the Fodder Plants Quality. Rostl. Výr., 6, p. 565-578.

Regal, V., Krajčovič, V., 1963: Forage production (in Czech). SZN, Praha.

Stählin, A., 1971: Gütezahlen von Pflanzenarten in frischen Grundfutter. Sonderheft 5, der Zeitschrift " Das wirtschaftseigene Futter", DLG – Verlag Frankfurt (Main).

Scehovic, J., 1995: Pourquoi et comment tenir compte des métabolites secondaires dans l'évaluation de la qualité des fourrages? Revue suisse Agric., *27*, 5, p. 297-301.

Šoštarič-Pisačič, K., Kovačevič, J., 1974: Evaluation of Quality and Total Value of Grassland and Leys by the "Complex Method", Zagreb.

Thaer, A., 1810: Grundsätze der rationellen Landwirtschaft. Band 3, Verlag G. Reimer, Berlin.

Voigtländer, G., Jacob, H., 1987: Grünlandwirtschaft und Futterbau. Verlag Eugen Ulmer, Stuttgart, ISBN 3-8001-3071-8.

Vries, D.M. De, t'Hart, M.L., Kruijne, A.A., 1942: Een waardeering van grasland op grond van de plantkundige samenstelling. Landbouwkundig, Tijschrift, *54*, p. 245-265.

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Predkladaná práca je metodického charakteru. Hodnotenie kvality trávneho porastu (E_{GQ}) sme overovali v priebehu desiatich rokov na 1200 floristických analýzach trávnych porastov v Západných Karpatoch. Na základe floristickej analýzy, ktorá pozostáva z pokryvnosti (D – dominancia) jednotlivých druhov rastlín v percentách vo floristických skupinách:

1. Monocotyledoneae (jednoklíčnolistové) – lipnicovité (Poaceae) – trávy
2. Monocotyledoneae – čeľade šachorovité (Cyperaceae) a sitinovité (Juncaceae) – trávam podobné druhy
3. Monocotyledoneae – čeľade Liliaceae, Orchidaceae a Iridaceae
4. Dicotyledoneae (dvojklíčnolistové) – leguminózy (Fabaceae)
5. Dicotyledoneae – ostatné čeľade dvojklíčnolistových bylín
6. Pteridophyta (papraďorasty) – čeľade Aspidiaceae, Equisetaceae, Hypolepidaceae, kde zvyšok tvoria Bryophyta (machorosty) s podielom prázdnych miest a ich kŕmnych hodnôt (FV) v trávnom poraste v škále od – 4 do 8 (tabuľka 1) zistíme kvalitu trávneho porastu v čerstvom zelenom stave výpočtom podľa vzorca:

$$E_{GQ} = \frac{\Sigma (D.FV)}{8}.$$

Hodnotenie kvality trávneho porastu (E_{GQ}) se pohybuje v rozmedzí od hodnôt nižších ako 0 (toxický), cez škodlivý, bezcenný, málohodnotný, menejhodnotný, hodnotný, veľmi hodnotný až po vysokohodnotný trávny porast s maximálnou hodnotou 100 a môže slúžiť pre výskumné a praktické zistenie kvality trávnych porastov. Výhodou predloženého hodnotenia kvality trávneho porastu v porovnaní s predchádzajúcimi hodnoteniami kvality iných autorov je širšia škála kŕmnych hodnôt, jednoduchosť výpočtu a praktické využitie 100 bodovej stupnice. Hodnotenie kvality trávneho porastu môže byť podkladom k rozhodnutiu o celkovej alebo čiastočnej obnove, prípadne revitalizácii prísevom pre zvýšenie jeho kŕmnej hodnoty. Medzi estetickou a kŕmnou hodnotou trávneho porastu je potrebné zvoliť kompromis. Pretože vysoký podiel estetických druhov má nízku kŕmnu hodnotu a nespĺňa požiadavky pre výživu zvierat, je potrebné porasty revitalizovať prísevom hodnotných až vysokohodnotných druhov podľa spôsobu a intenzity využívania, na úkor estetickej hodnoty porastu.