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Effects of grassland management on plant communities

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Grassland is an important component of agrarian landscape, providing a wide range of ecological, economic and social goods and services necessary to support life. They provide habitat for numerous plants and animals, filter sediment and pollutants before they reach our freshwater sources, increase water infiltration, prevent soil erosion, remove and store greenhouse gases, etc. Plant communities are the main elements of grassland ecosystems. The conditions of plant communities and species composition reflect the ecological conditions of the habitat and are an important bioindicator. Grassland plants have the amount requirements for ecological factors which are most suitable to them and optimal to the growth and development, however, economic activity carried out in grasslands may negatively affect the relation of ecological conditions and plants. Long-term changes of the conditions of a habitat, which are determined by various ecological factors, make an impact on the condition of plants and their competitiveness; thus species composition of communities also changes. Especially marked influence on the formation of grassland communities is made by anthropogenic factors, i.e. human economic activities (fire, drainage, fertilization, creation of sown grasslands, haymaking, grazing, or, contrariwise, abandonment). A review on the impact of anthropogenic activities on grassland plant communities is presented.

Key words: grassland value, plant communities, species diversity, grassland management, human activity

INTRODUCTION

Europe's grasslands are one of the most important biotopes. In its narrow sense, 'grassland' may be defined as ground covered by vegetation dominated by grasses, with little or no tree and shrub cover. The definition of grassland is quite wide and often determined differently. Firstly, grasslands differ in their origin, by the floristic composition and the composition depends on the season; there are no clear boundaries between different grassland types. Moreover, the formation of grasslands and their phytocenology change is a permanent process, therefore grasslands may be of various level of development; the opinion of scientists also differs whether all perennial communities of mesophytic plants are to be considered as grasslands. All the above-mentioned reasons as well as other reasons influence the differences of the formation of the concept of grassland. For other purposes, grassland is defined by its use, for example as "grazing land" (Faber-Langendoen, Josse, 2010).

Grasslands provide many benefits to the environment and society. They are an important source of food, provide forage, fibres and their potential to provide bioenergy has been also increasingly recognized. Grasslands have long been a traditional source of medicinal plants and other medicinal resources. They also have effect on the quality of surface water as well as groundwater and recharge. Grasslands cover probably the most diverse habitats in Europe and therefore are extensive repositories of biodiversity and genetic materials (Hönigová et al., 2012). Habitat for wildlife, nutrient storage, flood regulation, prevention of soil loss due to water and air

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erosion, maintenance of soil fertility is a very important non-market value of grasslands (Schellberg, Pontes, 2011). Other goals comprise ecologically important services such as enhanced carbon sequestration and the mitigation of greenhouse gas emissions as well as non-market benefits such as land conservation, the maintenance of landscape structure or even aesthetic value (Weigelt et al., 2009).

Several farming practices may affect biodiversity of grasslands: fire, use of organic and mineral fertilizers, grazing and haymaking, drainage or reseeding. In most cases, intensive and profitable grass production from grasslands appears to be incompatible with maintaining a high level of biodiversity (Plantureux et al., 2005; Harrison et al., 2003). However, grasslands have been developed over many centuries with permanent extensive use for agricultural purposes. Therefore the farmers are at the heart of grassland conservation. However, only extensive agriculture can preserve these grasslands (Pärtel et al., 2005). Current and future management goals should recognise the benefits of multifunctionality in grassland agriculture providing a large number of ecosystem services (Weigelt et al., 2009).

On grasslands, knowledge of factors affecting plant species composition and their abundance is the key to the understanding of productivity and forage quality and thus to successful management, too. Variation in floristic composition reflects intra- and inter-specific competition along environmental and management gradients (Schellberg, Pontes, 2011).

The aim of the article is to review the influence of anthropogenic activities on grassland plant communities.

MATERIALS AND METHODS

Environmental benefits of grasslands

Grassland is an important component of agrarian landscape distinguishing itself by a multifunctional role in the formation of landscape. Grasslands perform essential services necessary to support life, contribute to human well-being, and provide beneficial goods and services that extend to local, regional, and global communities (Fig. 1).

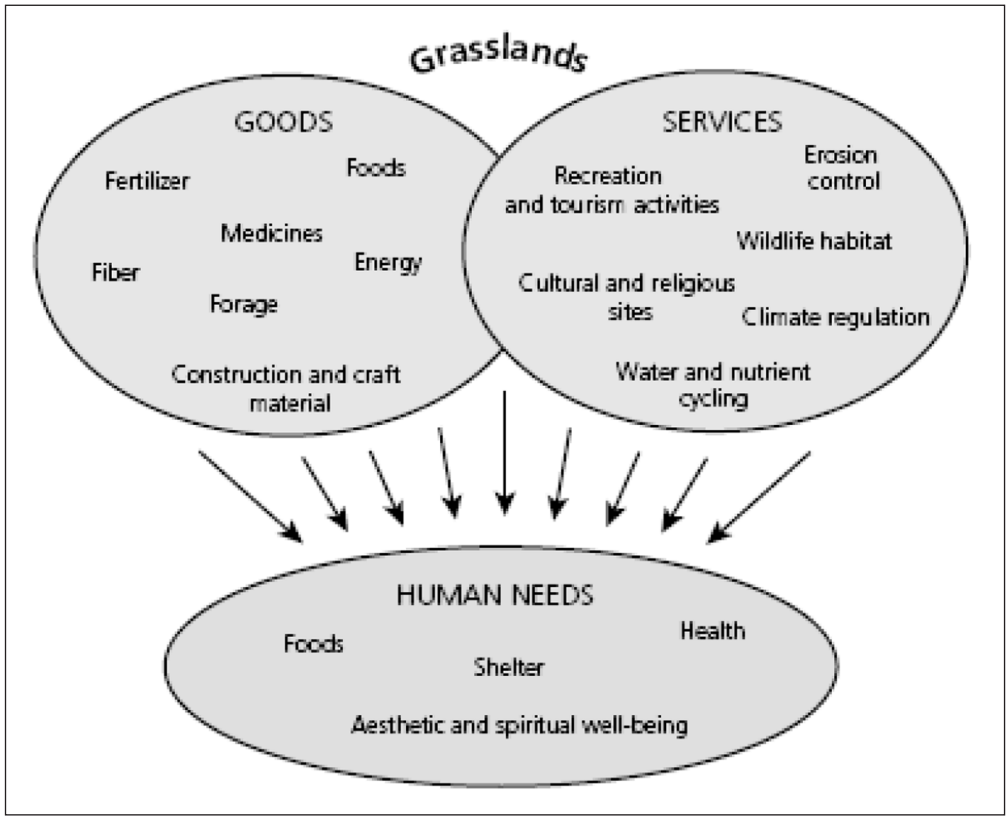

Fig. 1. Goods and services provided by grasslands (after White et al., 2000)

The main function of grassland is providing feed for livestock, but grasslands also serve other functions.

The habitats of grassland are very important storages of biological variety and a component of an agrarian landscape, having probably the largest biological variety. Grasslands in Europe contain an exceptional diversity of plants, insects (e. g. butterflies), birds or fungi (Hönigová et al., 2012). Up to several dozens of plant species may be found in one square meter of grassland. The variety of grassland plants is important in the economic, aesthetic and, unmistakably, ecological and landscape formation meaning. Grasslands also play an important role in water circulation in nature. Together with forests, grasslands play a significant role in the enlargement of air humidity (Jankowska-Huflejt, 2006). Grasslands have been a traditional source of medicinal plants and other medicinal resources. Pharmaceutical use of medicinal and aromatic plants is connected with the content of active substances such as oils or tannins (Hönigová et al., 2012). It is noteworthy that a natural mechanism of flood regulation is one of important ecological functions which are performed by flooded grasslands. Grassland service of water regulation can be defined as the influence ecosystems have on the timing and magnitude of water runoff, flooding, and aquifer recharge, particularly in terms of the water storage potential of the ecosystem (Hönigová et al., 2012). Moreover, grassland also performs an important function in decreasing the amount of gas causing the greenhouse effect in the atmosphere and in the solution of ecological problems in the global context. Grasslands have considerable potential to absorb carbon present in the atmosphere and thus contribute to the reduction of the amount of the main gas causing the greenhouse effect, namely CO_2 (Fig. 2). Thus grasslands can act as a significant carbon sink with the implementation of improved management (Conant et al., 2001).

Searching for additional sources of income to owners of grasslands, as well as to increase the production of bioenergy, more attention is paid to the possibility of using grassland biomass for energy needs, if both the herbaceous biomass yield and the chemical characteristics of the cut grass meet the needs. Since the burning of fossil fuel pollutes the environment and the stock is limited, grassland biomass for electric power and heat generation can be one of the renewable energy generation resources. Furthermore, the biomass of grasslands may be industrial raw material for the production of biofuel. Carbon dioxide exuded during the combustion of biomass is used for the cultivation of the very plants biomass; therefore the usage of such energy source maintains the balance in respect to CO_2, excluded to the environment (Heinsoo et al., 2010). The energetic potential of grassland plants biomass is large and may be used for the satisfaction of energetic needs (Kryževičienė et al., 2005).

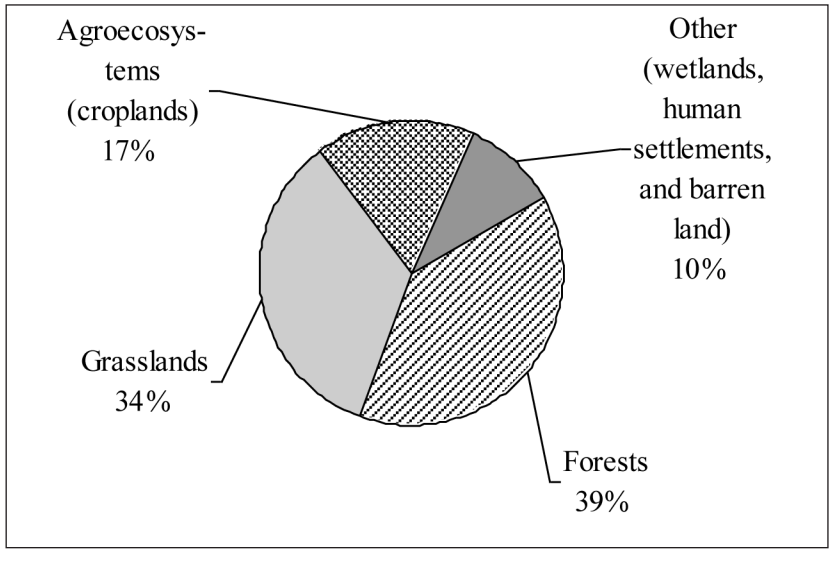

Fig. 2. Global stock of carbon in terrestrial ecosystems (after White et al., 2000)

The role of grasslands as a biological filter is no less important as it helps to decrease the negative impact of agriculture on the environment. When pollutants enter the grassland soil, they are rapidly decomposed due to the intensive activity of microorganisms of grassland soil. The system of grassland plants roots is very important in securing of the environment from the negative impact of heavy metals. Root accumulation and production were studied at two different grassland systems and under four different fertilization regimes in 1992–1998. A field trial was established in Banská Bystrica (Central Slovakia). The results confirm that the function of roots as a biological barrier of the first contact of grassland with heavy metals in the soil. There is the highest concentration of heavy metals, it declines in the tillering zone and far lower heavy metal concentration was found in plant tissues in the aboveground cover (Table 1). The content of heavy metals in forage production is thus not so dangerous in case of feed–food–chain because root system can accumulate them (Tomaškin, 2007).

Besides, the root biomass of grassland is an important resource of organic matter, which improves soil structure and fertility. A dense rooting of turf layer and a greater content of humus are important for better utilisation of soil humidity and cause a high ability to protect soil against nutrient leaching into water resources. The root system also protects soil against erosion (Jankowska-Huflejt, 2006). Owing to grasslands the effects of wind erosion and water erosion are reduced. Thus, indirectly, grasslands also protect water reservoirs against sedimentation by eroded materials (Starczewski et al., 2009).

Grasslands as largely open-air landscapes support recreational activities such as hunting, wildlife-watching, and tourism in general, and offer aesthetic and spiritual gratification. Grasslands as a component of agricultural landscape play a role in aesthetic enjoyment of landscape and social cohesion of rural areas (Hönigová et al., 2012) and in areas attractive to tourists may be used for recreational purposes as areas of high natural absorbance (Starczewski et al., 2009).

Impact of human activities on the change of grassland plant communities

Long-term changes of the conditions of habitats (chemical and physical properties of soil, irrigation conditions, etc.), which are determined by various ecological factors, influence the condition of plants and their competitiveness; thus later the species composition of communities changes (Svirskis, 2004). When the quality of plant communities changes, it affects all forms of life. The conditions of plant communities and species composition reflect the ecological conditions of the habitat and serve as an important bioindicator (Karpavičienė, Marcinkonis, 2009). Especially great impact on the formation of grassland plant communities is made by anthropogenic factors. There is no grassland completely protected from human activity. The communities of grassland are not constant and change due to such human activities as burning, drainage, fertilization, creation of sown grasslands, additional seed of herbs, haymaking and grazing, or, contrariwise, non-usage of grasslands. The most important effects of human activities on grassland plant communities are described below.

Fire

In Lithuania the burning of grasslands is forbidden. In 2000 the Code of Administrative Offences was supplemented with new articles related to the burning of grasslands. The ease with which grasslands are ignited, however, led to cases of senseless and destructive burning. These types of practice are commonly regarded by officials as dangerous because they often lead to fires of buildings and forests (Russel et al., 2009). However, in many foreign countries burning is applied as

Table 1. **Average heavy metal concentrations in soil and biomass of grass sward (mg · kg^{-1})**

Material tested	Heavy metals								
	Cd	Co	Cr	Pb	Zn	Mn	Cu	Fe	Ni
Soil	2.35	13.17	5.99	151.09	48.70	589.27	11.42	2 192.90	11.24
Roots	2.27	6.92	7.62	24.45	208.21	353.83	39.25	3 569.37	12.52
Sward	1.61	5.93	3.93	12.38	103.93	330.28	11.49	1 351.44	8.18

a means of environmental protection. The application of burning in various nature management schemes is evaluated ambiguously. Some scientists and nature protection specialists do not approve burning and motivate that this method destroys plants and animals, pollutes the environment and this is not a proper suspension of succession processes. In degraded or low-productivity grasslands fire may create monocultures of fire-resistant species and in some cases fire may be a significant promoter of exotic species. Other scientists believe that controlled burning is necessary seeking to sustain the development of grasslands which have formed historically (Harrison et al., 2003). However, flame is one of ecological factors affecting the development of the variety of grasslands. Flame is an important factor of the environment, most often of anthropogenic origin, which destroys and forms ecosystems at the same time. Fires occur very often in the grasslands of temperate climate zone. During fires, plants are affected by flame and high prelethal or lethal temperature. People think that the burning of grasslands improves the soil, regenerates and fertilizes it. Typical responses to fire include a flush of forbs germination and flowering and a transient increase in overall productivity as the removal of litter enhances the availability of nutrients, space, and light (Harrison et al., 2003), however, the structure of the soil changes; it deteriorates. The action of fire modifies the soil environment, hence changes in biological activity of the soil may be expected following burning (Russel et al., 2009).

Fertilization

The species composition of grassland plants is one of the most important signs of communities. Abundant scientific research indicates that due to the usage of mineral fertilizers the amount of nitrogen and phosphorus increases, thus the variety of grassland plants decreases (Schellberg, Pontes, 2011). Only few species of plants grow better in the soil saturated with nutritional substances. For example, the following plants are considered as the indicators of the soil rich in nitrogen: meadow foxtail (*Alopecurus pratensis*), orchardgrass (*Dactylis glomerata*), perennial ryegrass (*Lolium perenne*), cow parsley (*Anthriscus sylvestris*), nettles (*Urtica dioica*) (Karpavičienė, Marcinkonis, 2009). However, the largest variety of vegetation is observed in grasslands with small amount of nutritional substances (Plantureux et al., 2005). The decrease of the species variety of plants is explained by different abilities to compete for light. Light is one of the most important ecological factors influencing the growth of plants. In the competitive fight for light, taller and more rapidly growing plants have an advantage (Pärtel et al., 2005). In grassland saturated with nutritional substances, the relative difference of growth increases even more and only several species of plants may compete for light, overshadowing other species of plants. Also, the species of plants gradually start to dominate which are able to compete for light and which eliminate lesser competitive species; therefore the variety of the grassland vegetation decreases (Pykälä, 2007). Research into fertilizers has shown that the species composition of grassland plant communities highly depends on their fertilization. It has been established that a significant role of the number of plant species is observed even when the amount of used fertilizer is very low in comparison with the amount used in intensive agriculture. For example, the decline of a half of grassland plants species is observed when 20–50 kg of nitrogen for a hectare per year enter a grassland together with fertilizer (Plantureux et al., 2005). Furthermore, very often the usage of the nitrogen supplementing grasslands during fertilization (with mineral fertilizer, manure) is inefficient, its large amounts are washed out or enter the atmosphere. Therefore seeking to decrease the negative impact on the environment and economic losses, it is important to establish which amount of nitrogen present in fertilizer is assimilated by grassland plants most effectively, what amount of this nutritional substance, while fertilizing in various intensiveness, is washed out from grasslands soil or evaporates to the atmosphere, how different methods of usage influence the loss of nitrogen. For example, during the scientific research it was established that in case of a small outflow, a smaller amount of nitrogen enters the underground water when grasslands are mowed and grazed compared to only grazed ones (Jankowska-Huflejt, 2006) (Table 2).

The impact of phosphorus fertilizers on the variety of grassland plants is less known, however, it is firmly believed that large amounts of phosphorus have a negative impact on grassland ecosystems. Large amounts of organic fertilizers

Table 2. **The amount of nitrogen lost from grassland habitations and the concentration of nitrates in the underground water evaluating different methods of grassland management (the amount of used mineral fertilizer was different – 250 N kg · ha^{-1})**

Method of grassland management	Concentration of nitrates mg · dm^{-3}	Annual amount of lost N kg · ha^{-1}
Haymaking + grazing	45	9.5
Grazing	130	25.0

(manure) also influence the species composition of grasslands. Firstly, together with manure a large amount of nutritional substances enters the soil, besides, non-digested seeds of plants may be present in the manure which may germinate and thus due to non-typical plants the entire species composition of the ecosystems of grasslands may change (Plantureux et al., 2005). In 2008, an investigation was performed in Trakai district in the zone of spread pollution of an animal husbandry complex's sown grasslands watered with liquid manure. In the watered fields the land has not been cultivated for 20 years; during the last years the grasslands were irregularly grazed and mowed. During the research it has been established that due to the long-term fertilizing with liquid organic fertilizers, the grassland of low biological value formed. In the investigated lands watered with liquid manure, plants typical for fertile and highly fertile soil dominated, the majority of which are typical not to grasslands but to ruderal and semi-ruderal communities of perennial plants. During the investigation, negative correlation between the total number of plant species and organic carbon and total amount of nitrogen in the soil was established. In the investigated plots the number of plant species was lesser in the soil with larger amount of nitrogen and organic carbon, thus the investigation has proved that the number of plant species decreases in the soil with more nutritional substances (Karpavičienė, Marcinkonis, 20019).

Haymaking

In the protection of biological variety of grasslands ecosystems the peculiarities of haymaking are important, i.e. the number of harvests during the season and the time of haymaking, height of cut plants, the method of the management of the cut grass. The direct influence of haymaking is displayed by the rapid change of seasonal rhythm of vegetation, also by the accumulation of reserve nutritional substances; the maturation of seeds is unbalanced thus the plants able to adapt to the rhythm of haymaking start to dominate. Moreover, after haymaking the phytoclimate rapidly changes as more sun energy reaches the soil and lesser plant residues accumulate in the soil, thus the soil heats up better and dries and the circulation of gas between the soil and atmosphere improves. The haymaking of grasslands may be an important factor to the principal components of communities (Rimkus, 2003).

It has been scientifically proved that species variety of mowed grasslands vegetation is larger compared to grasslands which are mowed two or more times within a season. However, the grass of frequent usage (2–5 harvests) is of better quality by many indicators of intensive farming: nutritional substances, digestibility of organic and dry substances, palatability and other properties (Vasiliauskienė et al., 2007). However, after the evaluation of the material of the investigations in 1998–2006, performed in the territory of the Nemunas Regional Park, in the preservation zone situated in Ruguliai polder and non-flooded grasslands of Traksėdžiai village it was established that on average, within nine years, when grass was cut six times per season, the average harvest of grass was 3.37 t ha^{-1} lesser, when cut three times – 0.62 t ha^{-1} lesser in comparison with two harvests per season (Katutis, 2008). After the evaluation of the results of five tests performed in the lower reaches of Nemunas, the zone of the flood streams of the central alliuval soil and Šyša polder, it was established that the frequency of harvesting is the main factor determining the fertility of grassland and the quality of forage. When the number of harvests increases from two to five, the fertility lessens and the percentage of green proteins decreases. Although there are plenty of green proteins in the grass of five harvests, however, the grassland which is harvested many times annually impoverishes and weakens and low-value grass spreads, for example, rough bluegrass (*Poa trivialis*). In the meantime,

while harvesting two times, the amount of green proteins remains the same (Gipiškis, 2000). Often mowing is best tolerated by low plants having a lot of leaves near the ground, growing a large area of assimilation, for example, white clover (*Trifolium repens*), perennial ryegrass (*L. perenne*), etc., resistant to frequent mowing (Rimkus, 2003).

The time of mowing may have a direct and indirect impact on the plant communities of grasslands. A direct impact is related to the influence on the maturation of seeds of different plant species. Protecting the species variety of plants, the agri-environmental policies concerning grasslands have often promoted late harvests. The optimal time of mowing should be chosen after the end of plant flowering when grass seeds are matured and seeded out. For example, if mowing is performed when annual plants already start to flower, they do not mature seeds in time, therefore they may decline. Furthermore, after the mowing of grasslands, the competitiveness of plants for light declines, seeds get more light, therefore they germinate easier (Endels et al., 2007). This is the indirect impact of the time of mowing on the communities of grasslands. However, if mowing is performed later, the value of forage declines, therefore the mowing in intensive farms takes place in the beginning of June in Lithuania. During the investigations performed in the grasslands of the Nemunas River it was established that if the first harvest is performed later, the fertility of grasslands increases, but the quality of forage worsens. It is because the green mass desiccates with the increase of the percentage of dry substances, while the protein content lessens and reaches more than 20 percent at the end of May, and just 9–10 percent when the grass blossoms (end of June – beginning of July) (Gipiškis, 2000).

The method of the management of mowed grass also influences the botanical variety of grasslands. It is important that after the mowing the plants would be able to grow again until the first frost and would accumulate nutritional substances for the next season. Dry hay must be removed as a dense cover of dead vegetation of the last year inhibits seed germination and the growth of plants in spring, therefore the humidity regime flounders and the microclimate changes as well as the intensity of light. The soil is compressed and this stimulates the degradation of the grassland and the deterioration of the soil seeds bank (Harrison et al., 2003).

The height of the cutting of plants during mowing also influences the changes of the plant communities of grasslands. When the cutting is performed lower, the larger amount of mass is removed, plants grow less reserve substances and the surface of assimilation is lesser. Taller plants often have few leaves close to the ground surface; therefore such plants are impoverishing to a higher rate. For example, perennial ryegrass (*L. perenne*) persists better when cut higher. However, there are certain exceptions as some plants, when cut lower, produce more new sprouts. For instance, the genus of *Phleum*, when cut in the height of 2 cm, produces about six times more sprouts than cut in the height of 10 cm (Rimkus, 2003).

Grazing

Heavy grazing also negatively influences the communities of grasslands. During grazing, as well as during mowing, the natural development of grasslands is damaged, however, differently from mowing, grazing affects botanical diversity differently by selective defoliation due to dietary choices, trading, nutrient cycling. Grazing at low stocking rates is especially important to maintain the vegetation typical to the ecosystems of grasslands and prevents from covering with bushes and trees. The two main factors explaining plant species richness and related to grazing activities are the stocking rate (density of animals per hectare) and the duration of re-growth between grazing periods. When the grassland is used for grazing, the stocking rate should not exceed 1.5 animals per hectare, and re-growth duration should be at least 35 days in order the species variety of vegetation would not decrease. Intensive grazing produces short dense swards that generate low amount of seeds. Contrariwise, extensive grazing provides conditions for grasslands' grass to grow high and lush (Plantureux et al., 2005). In 1993–2002 the Lithuanian Institute of Agriculture performed a long-term research in Dotnuva, the aim of which was to establish the impact of extensive grazing on the vegetation of grassland. Before the period of the mentioned research, an investigation was also performed in 1961–1992. In experimental grasslands grazing was performed 3–4 times per season following a

rotation method. Before a cycle of grazing, seeking to evaluate the biomass of the grassland and to collect the sample of the green mass for the harvest of dry substances and the establishment of the amount of nutritional substances, the grass in the place of the research was cut to the height necessary for grazing. During the research, the species composition of plants was also evaluated. Summarizing the results of the research of 40 years it was established that communities rich in biological variety had formed in grazed grasslands. Long-term management of ecosystems of grasslands with extensive grazing of animals increased the number of plant types, maintained the natural fertility of grasslands and within a long period even improved the parameters of the soil (Gutauskas, Šlepetienė, 2004). It is important to mention that during grazing the surface of grasslands is intensively trampled. Trampling can have both a positive and negative effect on grassland. Trampling creates gaps in the sward and has a positive effect on the establishment of annual and bi-annual species. Trampling of the soil surface creates gaps thus allowing seeds to sprout, which in effect accelerates the growth of grasses. Grazing animals can protect specific plant seeds by churning the soil and creating mulches which cover them (Metera et al., 2010). Extensive grazing may be useful for the plants spread by seeds such as white clover (*T. repens*), dandelion (*Taraxacum officinale*), the plants of the genus *Plantago*, as animals emboss the seeds into the soil. Trampling also is useful for the plants spread by creeping stolons, for example, silverweed (*Potentilla anserina*), creeping buttercup (*Ranunculus repens*), or plants with shallowly situated rootstocks, for example, red fescue (*Festuca rubra*), kentucky bluegrass (*Poa pratensis*). Thus non-intensive trampling stimulates the vegetative propagation of plants. However, too intensive trampling, especially in case of wet soil, is harmful to the communities of grasslands (Rimkus, 2003). On the other hand, trampling may reduce stream bank stability and increase soil erosion (Metera et al., 2010).

Melioration

Multiplex melioration of grasslands determines the spread of new types of plants in these grasslands. The types of plants typical to wet grasslands decline when grasslands are drained and even larger decline of the biological variety of these ecosystems is observed after the grasslands are used more extensively. During the scientific-experimental research, made in France, the species composition of grasslands drained for periods ranging from 1 to more than 30 years, were compared. It was established that dominance of plant species had modified during the growing season following the drainage and that species disappearance or appearance significantly change after five years (Isselstein et al., 2005; Plantureux et al., 2005).

Abandonment

The plant communities of grasslands are not stable; vegetation responds to environmental conditions. The transformation of grasslands into arable lands or reseeding with cultural grass mostly influence communities, however, the abandonment of grasslands also has negative effect when due to the succession processes the plant communities of grasslands change. In such cases a considerable threat of the spread of grasslands' bushing, mainly with alders (*Alnus incana*) and young forest *Betula pendula* and *Salix* bushes, arises. After the grazing or mowing is terminated in abandoned grasslands, during succession plant communities of grasslands grow over with woody plants. In such conditions the natural habitat environment of plant species vanishes as natural succession takes place towards forest habitat formation. As agriculture has a lot of influence over the course of succession, the succession of communities in mowed and grazed grasslands is constantly influenced (suspended), therefore in such locations where naturally a forest should form, the ecosystems of grasslands are retained. In Lithuania, due to the conditions of local climate, all grassland plant communities, except flooded grasslands of river valleys, are related to human activity. Therefore when active economic activity is being terminated in these territories, the factors suspending succession vanish and in time forest habitations form (Isselstein et al., 2005). However, the process of succession may be also favourable for restoration of botanical diversity, when the abandoned and ex-arable lands gradually cover with the vegetation typical to grasslands or the species composition of sown grasslands becomes close to that of the communities of natural grasslands.

Intensification of the above-mentioned processes started after Lithuania became independent as considerable changes took place in agriculture, first of all related to the changes of the status of land property (ownership). The collective farms of the Soviet times practically ceased to exist and their lands were returned to the legal owners. Restitution (return of land) was performed and this essentially changed the nature of the usage of land. In certain regions of Lithuania the agricultural activity became detrimental, part of new farmers were unable to adapt to altered conditions of the market, therefore agricultural lands were poorly supervised and formerly cultivated land started to overgrow with bushes and trees (Ribokas, Zlatkutė, 2009). Renaturalization processes of the landscape took place. The Division of Landscape Geography and Cartography of the Institute of Geology and Geography performed scientific investigation, one of aims of which was to examine and to evaluate the structural changes of the landscape on the local level in 100 of the most problematic habitats. During the investigation a very comprehensive analysis using the reference habitats was performed within the period from 1974 to 2006. The result of the investigation showed that the renaturalization of the landscape was expressed through the abandonment of land and the conversion into forests, swamps and bushes, also, the transformation of arable land into grasslands. The process of cultural grasslands naturalization and grasslands restoration started. Despite these processes the data demonstrate the decline of a grassland ecosystem in Lithuania (Fig. 3).

As Lithuania became a Member State of the EU, new possibilities to preserve plant communities in grasslands appeared. The financial assistance to farmers for well maintained grasslands encourage them to take care, mow, and prevent the overgrowth with shrubs. In order to preserve botanical diversity of grasslands it is necessary to involve more people in the application of agrarian environment protection measures; for this purpose EU financial assistance is stipulated.

CONCLUSIONS

The plant communities, as the main structural element of grassland ecosystems, are distinguished by a multifunctional role in the formation of the agrarian landscape. The variety of plants accumulated in grasslands is important in the economic, aesthetic and, undoubtfully, ecological sense. Grasslands perform essential services necessary to support life, contribute to human well-being, and provide beneficial goods and services that extend to local, regional, and global communities. Apart from the provision of biomass for animal feed, grasslands provide other market or non-market environmental benefits such as habitats for wildlife, carbon sequestration, soil prevention against erosion, flood regulation, production of bioenergy. Grasslands also have filtration and detoxification

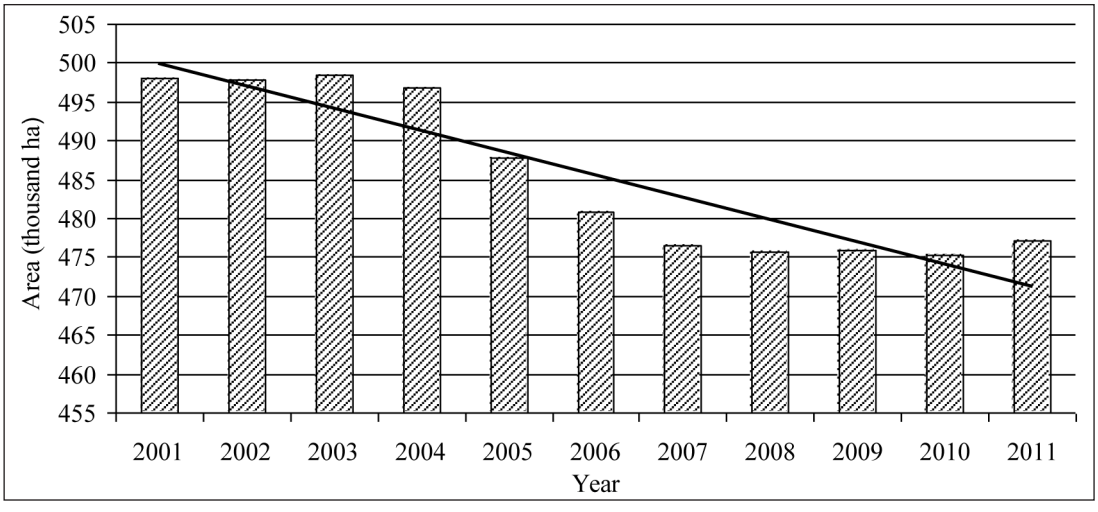

Fig. 3. Grasslands area changes in Lithuania during 2001–2011 (data of National Land Service under the Ministry of Agriculture, 2012)

property, root biomass of grassland is an important resource of organic matter. Furthermore, grasslands play an important role in aesthetic enjoyment of landscape.

Long-term changes of habitats influence the floristic composition of grasslands, their structure, the relations of plants and environment. The anthropogenic impact is one of the most important reasons due to which the habitats of grassland communities change. The plant communities of grasslands are negatively affected by such human activities as burning, drainage, fertilizing, creation of sown meadows, reseeding, intense mowing and grazing or abandonment. As a result of human activities the diversity of plant species decreases. The change of the quality of the plant communities of grasslands affects all forms of life. Seeking to preserve the diversity of plants of grasslands it is necessary to restrict the intensity of agricultural activities (fertilizing, mowing, grazing, usage of chemical control measures, etc.) or the abandonment of grasslands focusing on the priority of environment protection. Also, it is necessary to ensure sufficient payment for landowners who agree to maintain the biodiversity of grasslands.

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PIEVŲ TVARKYMO POVEIKIS AUGALŲ BENDRIJOMS

S a n t r a u k a

Pievos yra svarbus agrarinio kraštovaizdžio komponentas, atliekantis įvairias ekologines, ekonomines ir socialines funkcijas. Jos yra vertingos buveinės daugeliui augalų ir gyvūnų rūšių, taip pat natūralus nešmenų nusodintuvas, todėl į paviršinio ir požeminio vandens telkinius patenka mažiau teršalų; pievos saugo dirvožemį nuo erozijos, vaidina svarbų vaidmenį mažinant šiltnamio efektą sukeliančių dujų kiekį ir t. t. Augalai yra pagrindinis pievų ekosistemos struktūros elementas. Žolinių augalų bendrijų būklė ir rūšinė sudėtis atspindi augavietės ekologines sąlygas ir yra svarbus bioindikatorius. Pievų augalams būtinas jiems tinkamiausių ekologinių veiksnių kiekis, užtikrinantis optimalų jų augimą ir vystymąsi, tačiau ūkinė veikla pievose gali neigiamai veikti ekologinių sąlygų ir augalų santykius. Ilgalaikiai augaviečių sąlygų pokyčiai, kuriuos lemia įvairūs ekologiniai veiksniai, daro įtaką augalų būklei, jų konkurencingumui, dėl to vėliau kinta ir bendrijų rūšinė sudėtis. Ypač didelį poveikį pievų augalų bendrijų formavimuisi daro antropogeniniai veiksniai, t. y. žmogaus ūkinė veikla (gaisrai, pievų sausinimas, trąšų naudojimas, pievų pagerinimas jose įsėjant norimų augalų sėklas, šienavimas, ganymas ar priešingai – pievų apleidimas). Straipsnyje apžvelgiamas antropogeninės veiklos poveikis pievų augalų bendrijoms.

Raktažodžiai: pievų vertė, augalų bendrijos, rūšių įvairovė, pievų tvarkymas, antropogeninė veikla