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Ecological functions of vegetation as potentials of ecosystem services (floodplain alder forest in the Tríbeč microregion)

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Abstract

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Ecological functions of a black alder riparian forest (*Aegopodio-Alnetum glutinosae*) as capacities for the provision of ecosystem services were analysed and indicated by an inductive (bottom-up) approach. In July 2015, species richness and diversity of the forest stand were analysed in Hlboká valley, near Husárka water reservoir, Tríbeč Mountains, western Slovakia, by phytocoenological relevé, aboveground biomass of the herb layer and litter mass were estimated by a harvest method. The quantitative data obtained for the forest vegetation were used for estimation of capacities (potentials) of the floodplain forest to provide non-market ecosystem services. The forage, melliferous and therapeutic potential were estimated and calculated by Jurko's methods of ecological and socio-economic evaluations of vegetation. Aboveground biomass (production potential) of the forest understorey community was relatively high (seasonal maximum standing crop 59.03 $g \cdot m^{-2}$ in dry mass). The result of evaluation of the forage potential of the alder forest was higher than 50%, it means medium forage quality community. The melliferous potential was evaluated close to 190% (= high potential). The share of medicinal plants in the studied plant community was higher than 30%, referred to as extremely rich therapeutic potential. The analyses confirmed that the forest community represents high potentials for providing production ecosystem services.

Keywords: biomass; black alder forest; herbaceous understorey; provisioning and production services; western Slovakia

In the general classification of vegetation functions in the landscape, two basic groups of functions – ecological and social (or socio-economic) functions were distinguished (Eliáš 1983). Ecological functions were considered in systems of ecological relationships; they are important for the existence of natural ecosystems. Social functions of vegetation were considered in the system of human society relationships. They are products of the human society's needs and make use of the properties and effects of vegetation (Eliáš 2010).

Ecological functions of vegetation (*sensu* Eliáš 1983) determine/represent the capacity of the ecosystem to provide and to contribute to goods and services that satisfy human/human society needs (de Groot 1995). When the ecological function (the capacity) is actually used, it becomes a social or socio-economic function (*sensu* Eliáš 1983), now called "ecosystem service" (ES) (de Groot et al. 2012; Eliáš 2015a). Production of biomass is the ecological function of an ecosystem. If the biomass is used to satisfy human's/society's needs,

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it becomes social/socio-economic function(s), e.g. food, forage, fodder and fibre, fuel, ornamental resources etc.

Ecosystem services have been identified, mapped, quantified and valuated by different ways/approaches (Daily et al. 2002; Eliáš 2014; Grunewald, Bastian 2015):

(*i*) Deductive approaches (top-down) are concerned with deducing ecosystem services in a landscape from current ES categorizations/classifications. Four main ES categories were distinguished by Millennium Ecosystem Assessment (2003), The Economics of Ecosystems and Biodiversity – TEEB (http://www.teebweb.org), and Common International Classification of Ecosystem Services (CICES) projects: provisional, regulating, cultural and supporting services. In the last version of CICES regulation and supporting services were grouped into one section "regulation and maintenance services" (Haines-Young, Potschin 2013). The ES assessments are based on published data, expert surveys, public questionnaires. More general levels and valuation methods are used for estimation of the value of ecosystem goods and services (Sandhu et al. 2013);

(*ii*) Inductive approaches (bottom-up) are based on field studies of ecosystems (biocoenoses, plant communities) which occur in a study area, on collecting relevant data on their biodiversity, the localisation and geographical (spatial) distribution of the ecosystems in the area. ES are identified by ecosystem types (structure, biodiversity), and ecological functions are measured/estimated in the field (Eliáš 2013, 2014; Sandhu et al. 2013). The atomistic approaches are applied in the ES value assessment (Papánek 1978). The deductive and inductive approaches are quite different, but they can also be complementary (Eliáš 2015a).

In this paper we applied an inductive (bottom-up) approach to identifying and valuating of ecosystem services by the study of community phytodiversity (Eliáš 2014, 2015a, b). The aim of the study was to estimate selected ecological functions (production, forage, melliferous and therapeutic potential) of vegetation in a black alder riparian forest in the Tríbeč Mts. as potentials for providing ecosystem services.

This study demonstrates an example of using an inductive approach to the estimation of ecosystem services through the provisional ecosystem services. The field work presents a methodological approach and issues of the estimation of ecological functions of vegetation and providing ecosystem services according to Jurko's (1990) methods of ecological and socio-economical valuation of vegetation.

Jurko's (1990) evaluation of vegetation (plant communities) is based on plant species diversity analysed quantitatively by vegetation relevés and on ecological characteristics and socio-economic values (eco-numbers or eco-values) of plant species. The eco-numbers resulted from Jurko's (1990) experiences and compilation of results of long-term research, analyses, observations and knowledge of plant species. This is more than only the Slovak version of Ellenberg's eco-indices (Ellenberg et al. 1992). Jurko's (1990) methods have been successfully used by Slovak scientists in their scientific works up to now (Jankovič 2000; Kotrla 2007; Diviaková 2010; Kostúrová, Diviaková 2012; Tóthová, Halada 2015).

In our study, the alder forest community was selected because of its species richness and diversity. The forest community is a good representative for the interpretation of estimated ecological functions. The presence of water source is an important factor in the study site selection. It has an important role in providing ecosystem services (e.g. ecosystem processes or nutrition of wildlife).

MATERIAL AND METHODS

Study area. The field research was conducted in the Tríbeč Mts., Tríbečsko microregion, Zlaté Moravce district, western Slovakia. The sample plot was situated in the floodplain forest in the Hlboká valley, close to a small water reservoir Husárka, along the Hlboká brook, in the border of the Skýcov cadastre. Soil types of the valley belong to alluvial soils pseudogley with deep-lying G-horizon, less often semigley shallow or medium-deep alluvial soils to not gleyed soils (Weis 1967).

The floodplain forest community. Phytosociological sampling of the alder vegetation plots was carried out in the Hlboká valley. The cover of vascular plants was recorded using the original Braun-Blanquet seven-degree sampling scale (Moravec et al. 1994). Three-layered forest stands of alder [*Alnus glutinosa* (Linnaeus) Gaertner] were recorded in the following relevé. Plant nomenclature was united according to the latest Slovak checklist of plants by Marhold and Hindák (1998).

Relevé No. 1 – locality: Skýcov cadastre, Hlboká valley, near Husárka water reservoir, date: July 28, 2015, slope and exposition: 5°, altitude: 489 m a.s.l., plot area: 20 × 20 m – covers: E_3 (tree layer): 80%,

E_2 (shrub layer): 5%, E_1 (herb layer): 100% (recorded by Pavol Eliáš, sen.):

(*i*) E_3: *Alnus glutinosa* 4, *Carpinus betulus* 1, *Fraxinus excelsior* 2;

(*ii*) E_2: *Sambucus nigra* 1, *Corylus avellana* 1, *Acer campestre* +, *Acer pseudoplatanus* +, *Fagus sylvatica* +;

(*iii*) E_1: *Aegopodium podagraria* 2, *Impatiens noli-tangere* 2, *Impatiens parviflora* 2, *Circaea lutetiana* 2, *Stachys sylvatica* 1, *Asarum europaeum* 1, *Pullmonaria officinalis* +, *Galeobdolon luteum* 1, *Glechoma hederacea* 1, *Anthriscus sylvestris* +, *Melica uniflora* +, *Brachypodium sylvaticum* +, *Mercurialis perennis* +, *Urtica dioica* +, *Fraxinus excelsior* juv. 1, *Sambucus nigra* +, *Alnus glutinosa* juv. +, *Acer platanoides* juv. +, *Ribes rubrum* r, *Corylus avellana* juv. +, *Acer campestre* juv. +, *Rubus caesius* +, *Rubus idaeus* r, *Dryopteris filix-mas* r, *Chrysosplenium alternifolium* +, *Atropa belladonna* r, *Viola hirta* +, *Alliaria petiolata* r, *Carpinus betulus* juv. r, *Galeopsis speciosa* r, *Veronica montana* r, *Stellaria media* r.

The physiognomy of the herb layer was determined by two annual plant species *Impatiens noli-tangere* Linnaeus and *Impatiens parviflora* de Candolle, and two perennial forbs *Aegopodium podagraria* Linnaeus and *Circaea lutetiana* Linnaeus.

The above plot represents the black alder floodplain forest of the association *Aegopodio-Alnetum glutinosae* (Šomšák 1961; Karpáti et al. 1963), in literature referred to also as *Stellario nemorum-Alnetum glutinosae* (Lohmeyer 1957; Hrivnák et al. 2013; Slezák et al. 2013). The mesophilous and eutrophic riparian alder forests are distributed along small brooks in the colline belt. In the last decades many stands have disappeared due to drainage and stream regulation (Michalko et al. 1986; Szmorad 2011; Slezák et al. 2013).

The habitat quality of the riparian alder vegetation on mesic to humid sites along small brooks is strongly influenced by periodic floods during spring and by markedly declining water table in the growing season (Michalko et al. 1986; Ellenberg 2009; Slezák et al. 2013). Seasonal fluctuations of groundwater table, affected by large variability in soil moisture, resulted in the appearance of forest mesophilous and slightly hygrophilous species as well as nutrient-demanding species (Hrivnák et al. 2013).

The relevé was used to estimate species richness and diversity of the vegetation.

Sample plots. In the alder forest sample plot smaller plots were selected to estimate the following ecological functions.

Aboveground phytomass. Harvest method by direct sampling of plants according to Dykyjová et al. (1989) was used. Herb-layer plants were excavated from sample plots of 1 m^2, sized 0.5 × 0.5 m, in four quadrats (A, B, C, D). Harvested plants were first sorted according to species and then transported to a laboratory in Nitra. There they were oven dried at 80°C to constant mass. The dry mass was estimated separately for individual species.

Litter dry mass. Litter mass was estimated in a similar way like the aboveground phytomass. The litter was collected from the forest floor – soil surface of the same sample plots 0.5 × 0.5 m (A, B, C, D quadrats). It was divided into herbaceous, woody and fruit litter and then transported to a laboratory in Nitra (SW Slovakia), where it was oven dried at 80°C to constant mass. After drying the species and litter were weighed on an analytical balance.

The aboveground phytomass and litter dry mass were calculated per 1 m^2 on average.

Estimation of ecological and socio-economic functions of vegetation. Ecological functions of vegetation were evaluated using Jurko's (1990) methods of ecological and socio-economic evaluation (Jurko 1990). Besides ecological significance for herbivores, biomass has an important role in the stability of stands and in various beneficial functions of vegetation (Jurko 1990).

Production potential. The production potential of alder forest was expressed as a seasonal maximum of the understorey standing crop estimated in July 2015.

Estimations of the forage (P_f), melliferous (P_m) and therapeutic potential (P_t) were all based on the phytocoenological relevé and eco-numbers published for the plant species by Jurko (1990).

Forage potential. P_f represents the capacity of a plant community to be used/consumed as food (forage) by wild animals. Plants with the positive nutritional value represent the species which provide forage for animals. Negative nutritional values represent species which animals avoid. These species can smell bad, be toxic etc. In our calculation the species with a zero value were not considered. These species were considered to have no importance for the estimation of forage quality.

P_f was calculated from the phytocoenological relevé and Jurko's eco-numbers as the sum of positive percentage values minus the percentage of negative values of individual plant species (Jurko 1986, 1990). Species of the studied forest community were analysed quantitatively, from the viewpoint of the percentage share of positive (in 5 classes: 1 – inferior, 2 – low, 3 – good, 4 – very good, 5 – excellent) and negative (in 3 classes: 1 – undesired, 2 – harmful, 3 – very harmful) nutritional values of the plant species. Quality grade classes were empirically determined according to the scale of P_f span: –2 – inadequate (< –20%), –1 – ineligible (from –20 to –2%), 0 – zero (–2–2%), 1 – extremely low (2–10%), 2 – very low (10–20%), 3 – low (20–40%), 4 – medium (40–60%), 5 – high (60–75%), 6 – very high (75–90%), 7 – extremely high (> 90%). The maximum value of P_f represents 100%. More details about the methodology are outlined in Jurko (1986, 1990) and Eliáš and Mariničová (2015).

Melliferous potential. P_m represents the capacity of a plant community to produce nectar and pollen food and to produce honeydew which can be used by insect pollinators (bees). P_m was calculated from the phytocoenological relevé and Jurko's eco-numbers (Jurko 1990). The eco-values/numbers represent the intensity of nectar production, as well as the production of honeydew and pollen production. The following categories were distinguished: 1 – low, 2 – medium, 3 – good, 4 – very good. Quantitative significance of plant species (Jurko 1990) was determined/calculated from the phytocoenological relevé and its category for each layer of the community (tree, shrub, herb layer) separately. The sum of the categories of each layer is therefore higher than 100%, as follows: 1 – very low (< 20%), 2 – low (20–50%), 3 – medium (50–150%), 4 – high (150–225%), 5 – very high (225–275%), 6 – extremely high (> 275%).

Therapeutic potential. The total P_t represents the capacity of a plant community to collect medicinal plants which are identified and used in natural/official and folk medicine. It was calculated by a quantitative method as the percentage of medicinal plants in the phytocoenosis (Jurko 1990). We assessed the potential according to the percentage of medicinal plants in the plant community as follows: 1 – negligible (< 1%), 2 – very poor (1–5%), 3 – poor (5–10%), 4 – little rich (10–20%), 5 – rich (20–30%), 6 – extremely rich (> 30%) (Jurko 1990).

RESULTS AND DISCUSSION

Species richness and diversity

In the black alder riparian forest in the Hlboká valley we recorded 40 plant species, as documented by the phytocoenological relevé. The species richness of floodplain forests has ranged from 29 to 52 species with a mean of 40 taxa per relevé (Hrivnák et al. 2013). The black alder (*A. glutinosa*) is a dominant tree species. Of the accompanying species *Fraxinus excelsior* Linnaeus and *Carpinus betulus* Linnaeus can play a major (even codominant) role. Floristic composition is represented by the dominance of *A. podagraria*, *I. noli-tangere*, *I. parviflora* and *C. lutetiana*. An invasive alien plant *I. parviflora* negatively affects the original species *I. noli-tangere*, which can be suppressed. The same conclusion was drawn by Uherčíková and Eliáš (1987) and Faliński (1998), and further suppression of surrounding vegetation, including perennials was reported (Obidziński, Symonides 2000). The occurrence of invasive species indicates the presence of humans. Human activities can impair the flow of ecosystem services on a large scale (e.g. spread of invasive species).

Production potential

The seasonal maximum standing crop of the herb layer in *Aegopodio-Alnetum glutinosae* was 59.03 g·m^{-2}, on average 58.25 g·m^{-2} (Table 1). In the Low Carpathian Mountains, Kubíček and Jurko (1975) estimated the maximum aboveground herb layer biomass of 136.334 g·m^{-2} in *Stellario-Alnetum*. They used the combined method of indirect sampling and phytocoenological relevés, which can lead to certain variations and inaccuracies. Kollár et al. (2010) reported 53.6 g·m^{-2} in the Žalostínska vrchovina Hills. Kotrla (2007) presented the average dry matter of 57.12 g·m^{-2} produced by the herb layer in floodplain forests in Ďulov Dvor. Compared with the aboveground biomass of other types of forest communities (Kubíček, Jurko 1975), *Aegopodio-Alnetum glutinosae* is the most productive forest community here regarding the herb layer. This statement was supported by Kollár et al. (2010).

In the herb layer the most dominant species according to dry biomass (Table 1) were *A. podagraria* 20.67%, *I. noli-tangere* 18.63%, *C. lutetiana* 16.26% and *I. parviflora* 12.2% (Fig. 1). The coverage of these plant species is documented by the phytocoenological relevé as the same according to Braun-Blanquet scale 2 (15% on average). This dominant species in the community (according to its coverage) changed its position (the 4th place – according to number of individuals) with a maximum number of individuals 33 per m^2. It is evident that the dry mass underestimates the actual "importance" of the annuals in mixed communities. It is necessary for the future research to focus on the fresh matter of *I. parviflora* in a community. Our results are supported by Eliáš

Table 1. Aboveground biomass in sample plots in *Aegopodio-Alnetum glutinosae* community

Species	Dry mass of quadrats (g·m^{-2}) A	B	C	D	Total dry mass (g·m^{-2})
Impatiens parviflora de Candolle	1.70	0.70	3.50	1.30	7.20
Impatiens noli-tangere Linnaeus	3.40	4.10	0.80	1.90	11.00
Pulmonaria officinalis Linnaeus	2.40	0.50	0.00	0.08	2.98
Urtica dioica Linnaeus	1.00	1.10	0.00	0.00	2.10
Galeobdolon luteum Hudson	2.00	0.60	0.60	1.80	5.00
Circaea lutetiana Linnaeus	0.90	2.40	3.70	2.60	9.60
Acer campestre juv. Linnaeus	0.10	0.00	0.30	0.00	0.40
Aegopodium podagraria Linnaeus	0.70	1.30	3.80	6.40	12.20
Asarum europaeum Linnaeus	0.10	0.02	0.00	3.00	3.12
Fraxinus excelsior juv. Linnaeus	0.02	0.14	4.40	0.03	4.57
Stellaria media (Linnaeus) Villars	0.006	0.0045	0.00	0.00	0.0105
Veronica montana Linnaeus	0.10	0.00	0.00	0.00	0.10
Galeopsis speciosa Miller	0.00	0.03	0.00	0.00	0.03
Alliaria petiolata (Marschall von Bieberstein) Cavara & Grande	0.00	0.00	0.55	0.00	0.55
Ribes rubrum Linnaeus	0.00	0.00	0.10	0.00	0.10
Carpinus betulus juv. Linnaeus	0.00	0.00	0.07	0.00	0.07
Total					59.03

A, B, C, D – 0.5 × 0.5 m quadrats used for dry phytomass estimation

(1989), who stated that annuals exhibit extremely high water content in stems and leaves (above 90% of fresh mass) and the dry mass portion in the fresh mass of plants it also extremely low.

It would be interesting to observe *I. parviflora* and its abundance in communities with a dense herb layer for the future. Species richness in the herb layer could be significantly decreased with increasing abundance of *I. parviflora*. These associations were studied by Godefroid and Koedam (2010). However, it was not possible to highlight any negative effect of the invasive alien plant *I. parviflora* on the cover of *I. noli-tangere*. The coverage of these species is represented by 2 (15% on average) in the recorded phytocoenological relevé.

All these species were found in all investigated quadrats of 0.5 × 0.5 m in size. Other species were represented by about 5.00 g each and less, out of these species *Galeobdolon luteum* Hudson and *F. excelsior* occupied A, B, C and D quadrats. The species importance in a community is the best ranked by productivity, biomass, or coverage. These characteristics are independent of the concept of "individual" and more direct expression of importance than are numbers of individuals (Whittaker 1965). These results include information about the number of individuals and their individual biomass production.

By counting the individuals in sample plots, Kubíček and Jurko (1975) found on average 9 individuals of *Urtica dioica* Linnaeus, in our case it is 4 individuals, from 1 to 16 individuals of *I. noli-tangere* when our maximum is 34, *I. parviflora* maximum is 33, 2–35 individuals of *A. podagraria*, our maximum is 31. The biomass of *I. parviflora* individuals is 0.22 g and 3.10 g for *I. noli-tangere* on average.

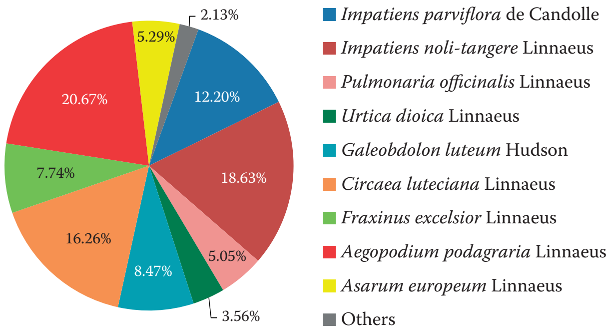

Fig. 1. Species composition of aboveground dry phytomass in sample plots in *Aegopodio-Alnetum glutinosae* community

Litter dry mass

Data on litter dry mass are given in Table 2. In the *Aegopodio-Alnetum glutinosae* community total litter mass was 619.30 g·m^{-2}. The largest part of the litter was represented by woody litter 59% (Fig. 2), ranging in quadrats from 39.60 to 133.60 g. The second largest part was found for herbaceous litter 38%, ranging in quadrats from 29.00 to 78.50 g. We suppose that the litter production depends on mean monthly temperature and mean monthly rainfall. Herbaceous or woody litter is the highest in deciduous forests during the autumn season. An important factor is the decomposition rate. Kumar and Tewari (2014) claimed that the decomposition rate of herbaceous (leaf) or woody litter is the highest in the summer season. The lowest rate of litter was documented in fruits (3%), ranging from 3.30 to 5.10 g.

A comparison between phytomass and litter is given in Fig. 3. Data clearly showed that the production of litter was more than 10 times higher as compared to the herbaceous layer. Supplies of litter depend on total production and annual growth (Sotáková 1982). Tree species associated with riparian areas (like alder, poplar and willow) produce rich-in-nutrients, soft, susceptible to decomposition litterfall, which is almost completely decomposed within the first year (Jonczak 2009).

Table 2. Composition and mass of litter in plots in *Aegopodio-Alnetum glutinosae* community

Litter	Litter mass of quadrats ($g \cdot m^{-2}$)				Total litter mass ($g \cdot m^{-2}$)
	A	B	C	D	
Herbaceous	60.80	29.00	78.50	69.00	237.30
Woody	91.40	39.60	133.60	99.90	364.50
Fruits	3.30	5.10	4.30	4.80	17.50
Total					619.30

A, B, C, D – 0.5 × 0.5 m squares used for biomass estimation

Forage potential

P_f of *Aegopodio-Alnetum glutinosae* is 52.5% (Table 3). It belongs to the 4th class, which represents medium forage quality of the community. Based on floristic composition, there are just two species, *Fagus sylvatica* Linnaeus and *Anthriscus sylvestris* (Linnaeus) Hoffmann, with a good and very good eco-value but the coverage of species is low. A significant impact on P_f is exerted by the presence of harmful species such as *Atropa bella-donna* Linnaeus but with very low abundance.

The estimation of P_f has also many methodological problems. Forage values of plant species are not divided into categories for each type of herbivore. Konôpka et al. (2005) presented their approach using the qualities (carrying capacity) of a locality for each type of wild herbivore according to the organic groups of forest types in Slovakia. This method represents the type of locality, not floristic composition. Other questions are: How many animals consume the forage? How many animals could feed on the available biomass? If one animal feeds on a particular species, it is not available to others. Novák (2008) published a similar conception of P_f estimation for livestock.

Jurko (1986) evaluated P_f of different plant communities. The highest P_f was undoubtedly that of grassland, what is confirmed by ecological evaluation of grassland in the Hodrušská hornatina highlands (Tóthová, Halada 2015). On the average, the lowest P_f was that of the highland and lowland forests or shrubby communities. The *Stellario-Alnetum* community counting by Jurko (1986) represents 34.7% low P_f, and the same community counting by Eliáš and Mariničová (2015) represents 15.5% very low P_f.

Melliferous potential

The P_m of the studied community was calculated as high, almost 190% – 4th class (Table 3). The supply of melliferous plants in floodplain forests found out by Jurko (1990) was good when P_m of *Salici-Populetum typicum* (Jurko 1986) was 267%, in a community with *Salix fragilis* Linnaeus the esti-

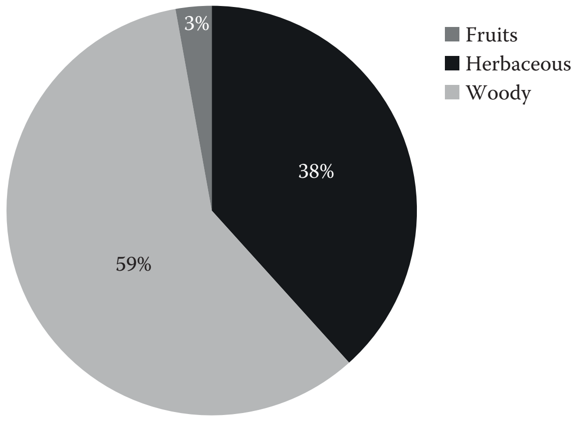

Fig. 2. Composition of total litter dry mass in representative plots in *Aegopodio-Alnetum glutinosae* community

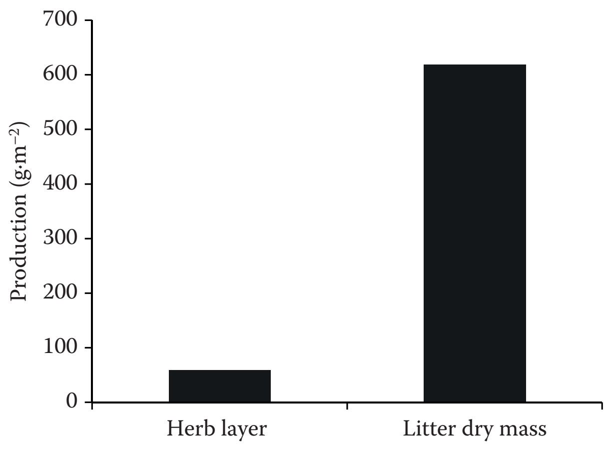

Fig. 3. Production of the herb layer and litter dry mass in sample plots in *Aegopodio-Alnetum glutinosae* community

Table 3. Estimation (evaluation) of forage (P_f), melliferous (P_m) and therapeutic (P_t) potential and eco-values of the investigated species

Layer	Species	P_f	P_m	P_t
E$_3$	*Alnus glutinosa* (Linnaeus) Gaertner	1	2–3	1
	Carpinus betulus Linnaeus	2	–23	0
	Fraxinus excelsior Linnaeus	2	–22	1
E$_2$	*Sambucus nigra* Linnaeus	0	2–2	3
	Corylus avellana Linnaeus	1	–22	1
	Acer campestre Linnaeus	1	21–	0
	Acer pseudoplatanus Linnaeus	1	422	0
	Fagus sylvatica Linnaeus	3	–22	3
E$_1$	*Aegopodium podagraria* Linnaeus	2	0	2
	Imaptiens noli-tangere Linnaeus	1	1–1	1
	Impatiens parviflora de Candolle	2	0	0
	Circaea lutetiana Linnaeus	1	0	0
	Stachys sylvatica Linnaeus	1	2–1	0
	Asarum europaeum Linnaeus	–2*	0	2
	Pullmonaria officinalis Linnaeus	0	2–2	3
	Galeobdolon luteum Hudson	1	2–2	0
	Glechoma hederacea Linnaeus	*	2–1	2
	Anthriscus sylvestris (Linnaeus) Hoffmann	4	1–1	1
	Melica uniflora Retzius	1	0	0
	Brachypodium sylvaticum (Hudson)	0	0	0
	Mercurialis perennis Linnaeus	–2*	0	1
	Urtica dioica Linnaeus	1	0	3
	Fraxinus excelsior juv. Linnaeus	2	–22	1
	Sambucus nigra Linnaeus	0	2–2	3
	Alnus glutinosa juv. (Linnaeus) Gaertner	1	2–3	1
	Acer platanoides juv. Linnaeus	2	322	0
	Ribes rubrum Linnaeus	0	2–2	1
	Corylus avellana juv. Linnaeus	1	–22	1
	Acer campestre juv. Linnaeus	1	2–1	0
	Rubus caesius Linnaeus	–1	2–2	1
	Rubus idaeus Linnaeus	2*	4–3	3
	Dryopteris filix-mas (Linnaeus) Schott	–1*	0	2
	Chrysosplenium alternifolium Linnaeus	1*	1–1	1
	Atropa bella-donna Linnaeus	–3	2–1	3
	Viola hirta Linnaeus	1*	1–1	0
	Alliaria petiolata (Marschall von Bieberstein) Cavara & Grande	1*	0	2
	Carpinus betulus juv. Linnaeus	2	–22	0
	Galeopsis speciosa Miller	*	1–1	0
	Veronica montana Linnaeus	0	1–1	0
	Stellaria media (Linnaeus) Villars	*	2–1	1
Total (%)		52.5	186.9	32.5

E$_3$ – tree layer, E$_2$ – shrub layer, E$_1$ – herb layer, eco-values: P_f: positive: 1 – inferior, 2 – low, 3 – good, 4 – very good, 5 – excellent, negative: 1 – undesired, 2 – harmful, 3 – very harmful, *at high coverage (over 3%); P_m: 1st value – nectar supply, 2nd value – honeydew supply, 3rd value – pollen supply, 0 – no supply for category, 1 – low, 2 – medium, 3 – good, 4 – very good, no value for investigated species (–); P_t: 0 – no supply for medicine, 1 – medicinal plants in natural medicine, 2 – standard drugs, 3 – official pharmacopoeia mated potential was low, the same as in a floodplain community in the middle of agricultural landscape (Kotrla 2009). Estimation of P_m should be developed. These results could be confused. It is necessary to know the actual number of flowers, because the estimation of P_m does not reflect this fact. It would be better to present results of the analyses of pollen, nectar and honeydew content. For more detailed study the activity of pollinators and the rate of flower pollination should be monitored.

For estimation of P_m it is important to know the supply of pollinators and beekeepers.

Therapeutic potential

P_t of the *Aegopodio-Alnetum glutinosae* community is 32.5%, it means extremely rich P_t, caused by high representation of medicinal plants (Table 3). Great therapeutic importance is represented by *A. glutinosa*. The genus *Alnus* Miller has been reviewed for its chemical constituents and biological activities including the traditional importance of some common species. The plants of this genus contain terpenoids, flavonoids, diarylheptanoids, phenols, steroids and tannins. The members of the genus *Alnus* are well known for their traditional uses in the treatment of various diseases like cancer, hepatitis, inflammation of the uterus, uterine cancer, rheumatism, dysentery, stomach ache, diarrhoea, fever, etc. (Sati et al. 2011). Jurko (1990) evaluated the community in the floodplain forest *Salici-Populetum typicum* as rich (25%) in medicinal plants. We assume that the supply of medicinal and therapeutic plants is higher in meadows (Eliáš 1991; Šalomon, Taylorová 2013). Another documented medicinal plant in the studied community is *U. dioica*. Stinging nettle has a great medicinal potential. It is used to treat rheumatism, as it provides temporary pain relief (Alford 2007). The extract of this plant is used in treating arthritis (Randall et al. 1999). The plant is also used for treating hay fever, hypertension and diabetes, and in phytotherapy (Ziyyat et al. 1997). It has antioxidant, antimicrobial, antiulcer and analgesic properties (Gulcin et al. 2004). Besides, the nettle has commercial uses, predominantly in the cosmetic industry.

CONCLUSIONS

In the studied floodplain forest community *Aegopodio-Alnetum glutinosae* 40 plant species were found and documented by the phytocoenological relevé. The seasonal maximum of the standing crop of herb layer was 59.03 g·m^{-2}; compared with aboveground biomass of other forest communities, it is the most productive forest community.

Production of total litter dry mass was 619.30 g·m^{-2}; the largest part of litter was represented by woody litter 59%. The valuation of ecosystem services based on ecological functions of vegetation by Jurko's methods (Jurko 1990) indicates that the community *Aegopodio-Alnetum glutinosae* provides medium forage quality for herbivores (52.5%), high P_m (186.9%) and extremely rich P_t for medicinal plants (32.5%).

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